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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

RECENT PROGRESS IN EMPLOYMENT STATISTICS [1]

By Aryness Joy, *Office of the Economic Adviser to the National Emergency Council*

Restoration of employment and enhancement of purchasing power in the hands of consumers are today major objectives of national policy. In the planning and execution of this policy, accurate and prompt information on employment, payrolls and hours worked is essential—reports on employment to indicate the number who have jobs; reports on employee-hours to gauge the degree of employment of those on the payroll, and, in conjunction with output, to measure productivity; reports on payrolls to measure aggregate wage income and average individual earnings.

In the early part of 1933, when information of this kind would have been especially significant for the formulation of policy, American statistical machinery was not adequately organized to provide it except in a few important industrial fields which had long been the subject of current reports by Federal and state agencies. Eighteen months later, in the autumn of 1934, a survey of current employment statistics finds the quality of basic information greatly improved and the number of industries covered by reliable monthly reports increased, so that it will soon be possible to summarize employment for more than half of the gainfully occupied non-agricultural population.

For the most part, the industries for which current information is complete are those in which large business units prevail and in which

[1] This paper is a report of progress in a field especially cultivated by the American Statistical Association's recent committee on Governmental Labor Statistics, and during the past year by the Advisory Committee to the Secretary of Labor in collaboration with the Committee on Government Statistics. The author, in several professional capacities and as an active member of the Advisory Committee, has figured largely in the developments here reviewed. The author desires that particular acknowledgment be made to Commissioner Isador Lubin, Sidney Wilcox, Lewis Talbert, Herman Byer, and Solomon Kuznets of the Bureau of Labor Statistics. To the staff of the Bureau is ultimately due much of the credit for the major improvements in employment statistics during the past eighteen months. The entire field will be treated in greater detail in a later report by the Advisory Committee to the Secretary of Labor.—Editor.

hired employees perform most of the operations. Typical are manufacturing, mining, railroads, utilities, chain and department stores, etc. A few large-scale employers of labor, however, are not currently reporting— state and local governments, schools, hospitals and other welfare organizations, many financial institutions, etc. In most industries reports cover wage-earners only; salaried workers were excluded from manufacturing reports, until recently, and no current data are available on employment of the managerial and supervisory personnel, principal officers of corporations, and proprietors.

The other great gaps in employment statistics are in smaller and less concentrated industries such as small retail stores and the service trades, representing millions of small establishments in which a large share of the work is done by the owner-proprietor; nor are the professions currently reported. In the field of agriculture, estimates can be made of the number of farm operators and of hired employees on a sample group of commercial farms, but of that increasingly important group of subsistence farmers nothing is known. The depression of the 30's made vivid the realization that the problem of employment is not merely one of hired wage-earning employees on whose activities most of our statistical information has centered, but also of a living for the self-employed of all classes. To attempt to estimate changes in total employment, and, more important, unemployment, without information on these very important occupations is to hazard a guess that may be very wide of the mark.

The principal source of data on the employed population has always been the decennial Census of Population, with the concurrent Census of Occupations. In 1930 the taking of a Census of Unemployment was resumed after a lapse of some time. Notwithstanding its imperfections, this has been for the past five years the bench-mark from which changes in unemployment have been reckoned. Comprehensive data on employment, although not strictly comparable with those of the Occupation Census, have been provided by the special industrial censuses, notably the biennial Census of Manufactures, the decennial Census of Mines and Quarries, quinquennial censuses of Agriculture and of the Electrical Industries, and, recently, the special Census of American Business covering the distributive trades and the service industries, continuing and enlarging the Census of Distribution and the Census of Hotels of 1929. Not only the population and occupational censuses, but even the industrial censuses are too infrequent and too long delayed in process of tabulation to provide answers to immediate questions of policy.

For immediate use monthly information has been collected through

questionnaires returned by representative employers, especially the larger establishments, at the request of governmental and other agencies. These reports are classified on an industrial basis and tie in closely with the industrial censuses rather than with the occupational census. Because monthly collection of reports is from a sample group of firms, it is necessary periodically to check the trend of changes in the number of their employees and the amount of their payrolls against those for the industry as a whole. Over a period of years a sample group of firms is almost certain not to be truly representative. For this reason, the development of adequate current statistics depends as much upon periodic complete enumeration on an industrial basis as upon the collection of monthly reports. Of necessity, the gathering of monthly information from employers rather than individuals makes difficult the covering of small independent establishments, the professions and other self-employed persons.

Monthly collection of employment reports from the payrolls of representative employers was inaugurated as early as 1914 by state departments of labor in New York and Massachusetts, among other states, and, on a limited scale, by the U. S. Bureau of Labor Statistics. At first only manufacturing wage-earners in a few important industries were covered. In the succeeding twenty years, however, this has been expanded to include almost all major manufacturing industries as well as other fields of employment—the public utilities, mining, etc.—and to extend to all parts of the country. For manufacturing a reasonably comprehensive nation-wide report was being collected by 1923. For several non-manufacturing industries, except railroads, the year 1929 marks the beginning of collection, although for a number of series an adequate reporting system dates only from 1933–34.

The collecting service for the United States as a whole is a joint undertaking of the U. S. Bureau of Labor Statistics, which is now the largest single collecting agency, and of state departments of labor, state universities, Federal reserve banks and other coöperating agencies in the leading industrial states. State agencies cover employment within their borders and forward the results to the Bureau of Labor Statistics, which assembles their data together with its own in a monthly report on employment, payrolls, and in some cases, man-hours. Derived figures representing average weekly earnings are also given, as well as hourly earnings and average hours worked per week for that part of industry reporting on man-hours. The reports cover only one pay period in each month, that ending nearest the 15th, and may therefore be only partially typical of the month as a whole.

The recovery program, and in particular the National Industrial

SUMMARY OF MONTHLY STATISTICS ON INDUSTRIAL EMPLOYMENT

I. Available in 1932 or 1933

Industry	Class of employees	Number employed in 1929 or 1930 (thousands)	Per Cent of total reported monthly	Collecting agency	Form of publication	Initial date of series	Rating and Comments
1. MANUFACTURING.....	Wage-earners	8,786[1]	47	BLS	Index 1926=100	1923	Fair. Coverage good. Trend of index in error.
2. MINING.....	Wage and salaried	[2]			Index		
Anthracite coal....	"	151	95	BLS	1929=100	1929	Excellent.
Bituminous coal....	"	480	65	"	"	"	Fair. State data not representative.
Metals.....	"	118	60	"	"	"	Fair.
Non-metal mines; quarries.....	"	104	70	"	"	"	Fair.
Crude petroleum....	"	158[3]	25	"	"	"	Poor. Coverage small.
3. PRS. AND PUBL. UTIL.							
Railroads, Class I.	All employees	1,687[4]	100	ICC	Total no.	1921	Excellent. Available by groups.
Tel. and Tel.....	Wage and salaried	400[5]	70	BLS	Index	1929	Excellent.
Light, power, gas..	"	287*	75	"	1929=100	"	Excellent.
St. rys. and busses	"	189[5]	70	"	"	"	Good.
4. GOVERNMENT.....							
U.S. Exec. depts...	All employees	550[6]	100	CSC	Total no.	2/25	Good. Payrolls not reported.
5. SERVICE INDUSTRIES.							
Hotels.....	Wage and salaried	314[7]	55	BLS	Index 1929=100	1929	Fair. Geographical distribution could be improved.
Laundries, power...	"	250[1]	30	"	"	"	Fair. Hand laundries not covered.
Dyeing and cleaning	"	66[1]	25	"	"	"	Fair. Small cleaners not covered.
6. CONSTRUCTION.....		[8]					
Public Rds. Fed., State..	All at site	220	Fairly complete	B.P.Rds.	Total no.	1931	Fair.
Oth. Fed. const...	All employees	75		FESB	"	7/32	Fair.
Private bldg.....	" " ex. off.	1,800	Small	BLS	% change	10/31	Poor. Sample small. Geographical distribution unbalanced.
7. TRADE.....		[9]					
Wholesale.....	Wage and salaried	1,605	7	BLS	Index 1929=100	1929	Very poor. Coverage bad. Trend not correct. Some lines not canvassed, others overweighted. Indexes unweighted.
Retail.....	"	4,510	10	"	"	1929	
8. FINANCE, etc.....							
Real est., ins., banks, brokerage houses, combined...	All except executive officials	1,200[3]	15	BLS	Index 1929=100	1929	Very poor as a group; trend in error and index misleading, unweighted. Life ins. coverage good; brokerage, banks, fair; real estate very poor.

II. Improvements and Additions to August, 1934

II. Improvements and Additions to August, 1934

9. MANUFACTURING							
.....	Wage-earners	8,786[1]	58	BLS	Est.no. Ind.1923-25=100	1919	Excellent. Index adjusted to Census trend. Coverage improved.
.....	Salaried	1,328[1]	?	"	% change	8/34	Just beginning.
10. RAILROADS							
Class I.....	All employees	1,687[4]	100	ICC	Ind.1923-25=100	1923	Indexes adjusted and unadjusted for seasonal variation.
Express companies...	All employees	59	100	"	Total no.	1/34	Excellent.
Pullman Co.....	" "	29	100	"	" "	7/34	Excellent.
11. GOVERNMENT							
U.S. Military, Legislative, Judicial...	All employees	260	100	BLS	Total no.	12/33	Excellent. Payrolls also from this date.
CCC.....	" "	---	100	ECW and BLS	" "	5/33	Excellent.
CWA.....	" "	---	100	FERA	" "	11/33	Excellent. Figures available wkly.
Emer.Wks. Program...	All exc.adm'n.	---	100	FERA	" "	3/34	Excellent. Preliminary weekly, also final monthly.
12. CONSTRUCTION							
Public							
PWA.....	Workers at site	---	Almost	BLS	Total no.	10/33	Good. Classified by projects.
Proj.financed RFC..	not office	---	complete	"	" "	4/34	Good.
Private building....	"	1,800[8]	?	"	% change	10/31	Improved. Coverage enlarged.
13. TRADE							
Retail.....	Wage,salaried	1,605[9]	28	BLS	Index 1929=100	1929	Coverage greatly improved. Indexes being revised; indexes now published poor.
Wholesale.....	" "	4,510[9]	22	BLS	"	1929	
14. FINANCE, ETC.							
Banks.....	All exc. off.	400[3]	35	BLS	% change	--	Improving, on basis FDIC data.
TOTAL, ALL GAINFULLY OCCUPIED, EXC.AGRICULTURE		36,356					

Note: All figures approximate.

Sources: 1/ Census Manufactures, 1929. Excludes mfgd. gas and motion pictures. 2/ Census of Mines, 1929 for all mining figures except crude petroleum. 3/ Census of Occupations, April 1930, with adjustments for executives and officials. 4/ ICC. 5/ Census of Electrical Industries, June 30, 1932. 6/ Civil Service Commission. 7/ Census of Hotels, 1929. 8/ Estimated for 1929, partly on basis of volume of construction. 9/ Census of Distribution, 1929. *Census of Electrical Industries 1932 and estimate for mfgd. gas.

Recovery Act, made more pressing the need for adequate information on employment and earnings in many industries and at the same time provided new avenues through which it might be obtained. In the winter of 1933–34, with a grant of CWA funds, the Bureau of Labor Statistics organized a project, under the direction of Mr. Roswell F. Phelps of the Massachusetts State Department of Labor and Industries, to expand the reporting list of firms by visits of field agents. While attention was concentrated on retail and wholesale trade, effort was also made to extend the reporting list in certain manufacturing lines and in other industries in which the current sample was below average. By this means more than 60,000 establishments were added. An active coöperative effort is now being made by the Bureau of Labor Statistics and state agencies, the Central Statistical Board, the NRA, and certain code authorities, to extend reports into new fields, to build up reporting lists and to make a complete canvass for certain industries once a month; for others, at least once a year. This will provide data needed for policy-making purposes and at the same time is calculated to prevent duplication of requests to employers for reports. Within a short time, therefore, the picture of employment will be more nearly complete than at present.

The accompanying tabular summary presents an analysis of the field covered by monthly statistics of employment in the autumn of 1934 as compared with those in use in 1932 or early in 1933. For most industries, reports on payrolls are available currently from the same sources and are presented in the same form, except in a few cases which are indicated. Payroll statistics raise a number of special questions which are not discussed in this article. Reports on total hours worked are considerably less comprehensive than for employment and payrolls, since collection of this information began more recently and many firms do not keep adequate records. For this reason comments on data on man-hours are not included.

The adequacy of the sample reported in each industry, measured as a percentage of total employment as indicated by the Census or other complete reports, is given, and also a rating of each industrial series, based on a personal appraisal of a number of factors, such as geographical representativeness of the reporting firms, the accuracy of trend reflected in the series, the degree of perfection of the index numbers, etc.

The summary shows that on a generous estimate, industries employing 35 per cent of gainfully occupied non-agricultural workers in the United States were reliably represented in national monthly statistics of employment late in 1932 or early in 1933. In 1929–30 these industries employed about 14,000,000 of the 38,350,000 workers gainfully

occupied outside of agriculture. For the most part they are industries that are typically large-scale.

Partial but quite unsatisfactory information was also available monthly on employment in construction, in certain branches of wholesale and retail trade and in the financial field. These combined groups employed an additional 25 per cent of the gainfully occupied non-agricultural workers. There were three principal reasons for the unreliability of these data as they were then presented — inadequacy of the sample; major errors in trend because of the use of a chain index in the absence of periodic reports for the entire industry; and lack of balance in the list of reporting firms, both geographically and with respect to special lines of business. This rendered misleading the index numbers that were made up without special weighting for these factors. It is in this group of industries that the greatest improvement has taken place with respect both to the enlargement of the reporting list and to technical improvements now under way in the index numbers.

The progress recently made in each of these major fields of employment and also in other fields is discussed in greater detail in the following paragraphs, which also summarize the recommendations of the Advisory Committee on Labor Statistics, appointed by the President of the American Statistical Association in March, 1933, at the request of the Secretary of Labor.[1]

MANUFACTURING

Current reports for wage-earners in manufacturing were generally quite satisfactory with respect to coverage in 1932–33 when the Committee made its analysis. In the Bureau of Labor Statistics' reports, 90 industries were represented, employing in 1929 about 85 per cent of all wage-earners shown by the Census of Manufactures and paying about the same proportion of the total factory wage bill.[2] Each of the

[1] A progress report of the work of the Advisory Committee is included in the summary report on the work of the Committee on Government Statistics, given elsewhere in this issue. The Advisory Committee and its staff have worked with the members of the staff of the Bureau of Labor Statistics, offering technical advice and administrative assistance. In analyzing data published by the Bureau of Labor Statistics, the committee has given attention to the following points:

1. Analysis of the coverage of monthly reports and suggestions for improvement with respect to number or to representativeness according to size and geographical distribution.
2. A check of the trend of reported data against more comprehensive (usually Census) material; and recommendations for such adjustments that final reports would give the most accurate possible picture of long-time developments.
3. Technical recommendations for procedure in computing index numbers, and in analyzing the data and presenting them for publication.
4. Coöperation by the Bureau with other agencies.

[2] In general the industry classification follows that of the Census of Manufactures. In some cases, however, more than one Census "industry" is represented in an "industry" as classified by the Bureau of Labor Statistics. In view of different classifications now being used for code-making purposes under NRA, some elaboration of this classification may be introduced.

90 industries is represented by a selected list of firms. The proportion of employment currently reported varied considerably between industries, but on the average was somewhat over 50 per cent. For some industries representation was practically complete, and in only seven industries did it fall below 30 per cent as tested by census reports for 1931. For five of these industries there has since been material improvement; for the other two—turpentine and rosin and cottonseed oil—the sample is still inadequate.

For manufacturing as a whole coverage was not so representative in the Southern industrial states as in the Northern and Western states. However, some 5,000 firms have since been added to the reporting group as a result of work done as a CWA project in 1933–34, and many of these are in Southern states. At the present time a considerable expansion is under way, especially in manufacturing, through the joint project of the Bureau of Labor Statistics, the NRA, the Census Bureau, and code authorities, mentioned above. Mailing lists are being provided by the code authorities, and the Bureau of Labor Statistics is acting as a collecting agent to obtain an almost complete current picture of employment, payrolls and man-hours in these industries. For other industries a complete survey is being made for one month, and a well-balanced sample, selected both geographically, by size of town, and by size of establishment, will be chosen for current monthly reports. Reports so far have been collected for only a few industries, among them wool textiles, men's clothing, fertilizers and paper boxes. The program is being rapidly expanded, however, and will soon be quite extensive.

In the summer of 1933 when the Advisory Committee on Labor Statistics began its work, the basic data underlying the indexes of factory employment and payrolls were made up on the basis of percentage changes from the previous month as shown by a group of reporting firms which was identical for each pair of months. Chain relatives were computed, and later converted to a 1926 base. Because of the use of a chain the indexes did not reflect adequately either the entrance of new firms into the industry or the final disappearance of established firms. Any accidental variations in monthly fluctuation or in trend due to unrepresentative sampling or even to rare cases of erroneous reports or arithmetic errors, became a permanent part of the chain. As a result the indexes had a tendency to develop considerable bias over a period of years. From 1923 to 1929, the index of factory employment developed an error of about 11 per cent, the index of payrolls about 9 per cent. Translated into number of men and dollars paid in wages, this meant that anyone using the indexes then published by the Bureau to compute the changes between 1923 and 1929 would

have understated the number of wage-earners employed in 1929 by nearly a million men and their total annual payroll by nearly a billion dollars. This discrepancy had been recognized by the staff of the Bureau and revision was already under way early in 1933. The indexes for each industry were being adjusted to the trend of employment and earnings shown by the biennial Census of Manufactures, and other improvements were in process. The Advisory Committee made a number of suggestions, among which were the following:

1. The use of the average of the 3 years 1923–25 as a base period. The purpose was to make the indexes readily comparable with those for production, car-loadings, etc. prepared by other government departments; to avoid the use of a single year in which inter-industry relationships are likely to be out of line. The 1923–25 base was recognized as a temporary expedient. It will soon be necessary to change to a more recent period in order to include new figures.
2. The use of weights for each industry representing actual number of men employed and the actual total weekly wage bill as shown by the Census of Manufactures. These weights were to be applied to the indexes for each industry after adjustment of the trend of each index to that shown by the Census of Manufactures.
3. The use of a group weighting system, and an adjustment of group indexes and of the total index, as well as indexes for individual industries, to trends shown by the Census of Manufactures.
4. Other minor changes such as the inclusion of the canning and preserving industry, hitherto omitted, with manufacturing; the inclusion of data in the index for the years 1919–1922 on the basis of the Federal Reserve Board's indexes.
5. The publication of a special bulletin describing the new indexes, with annual or biennial supplements giving revisions because of adjustments to subsequent census data, the addition of new series, etc.

All of these recommendations have been followed.

The Bureau's revised indexes were first made available to the public in April, 1934. They represent a great improvement over those previously issued because of many technical changes introduced, but primarily because they reflect accurately the long-time trend of employment and earnings.

Certain technical problems remain to be given further study, among which are the method by which adjustments to the trend shown by Census reports has been made for the years 1919–1931; the devising of a method by which payrolls, reported for only one pay period in each month, may be reduced to an average daily basis more typical of the month as a whole and less influenced by holidays and other accidental variations; and the improvement of reports on man-hours. A number of these apply with equal force to non-manufacturing industries. For the future, analysis by the Bureau of seasonal variations in employment and earnings in manufacturing has been recommended by the Advisory Committee. The Federal Reserve Board now publishes seasonally

adjusted indexes of factory employment based upon the Bureau's revised indexes.[1] However, no analysis of seasonal variations in payrolls has as yet been made.

The foregoing discussion has been concerned solely with factory *wage-earners*. Until recently *salaried workers* have not been included in monthly reports for manufacturing returned to the Bureau of Labor Statistics; current information on the employment and earnings of office employees in manufacturing is collected only for Wisconsin and for one month in each year for New York State. The nation-wide collection of these data was inaugurated by the Bureau of Labor Statistics and coöperating state agencies in September, 1934. It is too soon to analyze the completeness of the returns, which have been requested from the same firms that report on wage-earners, but the step is clearly in the right direction.

MINING, PUBLIC UTILITIES

For wage-earners in the mining industry coverage is reasonably satisfactory. Enlargement of the sample would be profitable in the case of crude petroleum; and also for quarries and non-metallic mines. The geographical distribution could also be improved, notably in the bituminous coal industry. It is impossible to determine whether the trend shown by these indexes since 1929 is representative of each branch of the industry as a whole, except possibly in the case of anthracite mining, for which reports are practically complete. Only a decennial Census of Mines is taken and annual reports to the Bureau of Mines are based on different definitions from those used by the Bureau and the Census. The provision for more frequent complete reports, which may be made possible by the code authorities, would contribute most to the improvement of knowledge of employment in mining.

Among the public utilities, monthly reports collected by the Interstate Commerce Commission for Class I railroads, covering over 90 per cent of all railroad employment, are complete for all classes of employees, and recently, monthly reports for Pullman and express company employees have been added. For other public utilities the coverage of wage-earners and salaried workers, as tested by the Census of Electrical Industries of 1932, is quite generally adequate, although it might be improved for street railways and allied bus companies and also for gas works, which are included here rather than with manufacturing. The important common carriers for which no reports are available are independent motor bus lines not affiliated with street railways, motor trucks, pipe lines, and water transportation.

[1] For a description see the *Federal Reserve Bulletin* for June, 1934.

For both mining and public utilities, data are given by types of enterprise in the form of index numbers on a 1929 base without seasonal adjustment, with the exception of railroads, for which the Interstate Commerce Commission compiles monthly index numbers, both with and without seasonal adjustment, on the base period 1923–25, for the years since 1923. Basic monthly data are also available for 1921 and 1922. The Anthracite Bureau of Information has reports for years prior to 1929. With these exceptions, reports for the mining and utilities group as a whole date from 1929, with none-too-complete reports for early months.

Estimates of the total number engaged and the aggregate weekly payrolls in each of these industries are made up from these index numbers multiplied by weights derived from Census data, except for railroads, which are reported completely. These aggregates have not yet been published, but are compiled currently in order to obtain group totals and, in combination with similar aggregates for other industries, to estimate changes in all reported industrial employment.

TRADE

It is in the group of industries comprising trade that the greatest improvement has recently been made in the adequacy of current reports, largely through the means of the field survey organized as a CWA project in the winter of 1933–34, mentioned above.

In the summer of 1933, monthly reports covered an estimated total of 10 per cent of all employees in retail trade, in wholesale trade about 7 per cent. Only 17,000 retail and 2,900 wholesale establishments were reporting. For the years 1929 and 1930, the sample was considerably less satisfactory, covering less than 8,000 retail and 2,000 wholesale firms. The distribution of the samples geographically was also very unrepresentative. Massachusetts, which had developed the most comprehensive reporting service in the country, represented four times its correct proportion of the total in employment in both retail and wholesale trade. The distribution by lines of trade was also disproportionate. In retail trade, department stores, represented by about a 35 per cent sample of employees in all stores of that type, comprised half of aggregate employment, or five times their proper weight. Mail order houses and chain grocery stores were fairly well covered, but like department stores, they formed a disproportionate part of the total. In contrast, the important automotive group had about a 1 per cent sample, food stores as a whole had a 9 per cent sample. For only five lines of trade did the reported sample exceed 10 per cent, for most it was less than 5.

MONTHLY REPORTS ON EMPLOYMENT IN WHOLESALE TRADE
BUREAU OF LABOR STATISTICS

Line of trade	Census - 1929		B. L. S. Monthly Reports			
			No. of stores		No. of employees	
	No. of stores	No. of employees	Aug. 1933	Aug. 1934	Aug. 1933	Aug. 1934
TOTAL, ALL LINES.....	169,702	1,605,042	2,947	15,440	80,085	275,127
WHOLESALERS ONLY.....	79,840	912,143	2,584	11,684	70,578	224,683
Amusement, sport goods.....	916	10,444	9	91	89	1,550
Automotive.....	3,451	54,538	102	729	1,840	10,541
Chemicals, drugs, etc.....	2,376	39,014	185	474	6,459	12,464
Dry goods and apparel.....	7,383	90,432	126	1,080	5,632	20,189
Electrical.....	2,182	34,854	71	344	1,150	5,343
Farm products, n. e. s.....	3,915	38,301	20	235	350	5,105
Farm supplies, ex. mach.....	1,158	13,737	32	173	853	2,969
Food products, n. e. s.....	15,433	129,469	465	2,211	11,353	43,434
Forest products, ex. lumber..	648	4,319	1	22	7	951
Furniture, house furnishings.	1,750	23,426	59	313	1,239	5,352
General merchandise.....	246	13,551	13	77	977	2,331
Groceries, etc.....	9,085	112,527	693	1,613	17,899	34,598
Hardware.....	1,249	41,497	186	424	9,092	15,637
Iron and steel scrap.....	3,919	21,679	3	110	104	2,001
Jewelry, optical goods.....	1,922	15,554	40	179	527	2,631
Leather goods, ex. gloves, shoes.....	1,161	6,210	21	121	395	1,355
Lumber, building materials...	3,774	53,844	78	385	1,377	6,100
Machinery, equipment, supplies, ex. electrical...	6,177	61,232	121	682	2,102	9,976
Other metals and minerals, ex. petroleum and scrap....	1,680	22,212	82	283	1,609	5,822
Paper and products.....	2,297	31,513	77	460	2,256	9,017
Petroleum products.....	3,119	23,285	28	511	1,685	6,317
Plumbing, heating equipment..	1,704	25,018	58	379	912	5,925
Tobacco and tobacco products.	1,721	13,726	55	295	1,378	4,866
All other.....	2,554	31,761	59	488	1,293	10,139
OTHER DEALERS AND AGENCIES....	89,862	692,899	363	3,756	9,507	50,444
Bulk tank stations.....	19,587	79,016	48	1,756	661	14,602
Chain-store warehouses.....	559	26,442	7	44	119	3,061
District sales offices.....	76	8,837	28	19	678	362
General sales offices.....	98	12,573	-	8	-	484
Manufacturers sales branches.	16,515	306,678	240	1,119	6,763	17,605
Cooperative sales agencies...	79	2,717	-	90	-	1,593
Agents and brokers.....	18,388	104,498	28	297	638	3,349
Assemblers and country buyers	34,143	116,026	12	345	625	3,007
Wholesaling manufacturers....	417	35,912	-	78	-	1,481

In wholesale trade, representation was also inadequate, but the distribution by lines of trade was less seriously awry. Employment in wholesale groceries was a disproportionately large fraction of the total, while for stores dealing in farm products, machinery, etc. representation was too small.

The considerable improvement in coverage in both wholesale and retail trade as a result of the addition of new firms is indicated by the table, which shows that for retail trade as a whole 40,000 new establishments were added, for wholesale trade 12,000. It is especially

MONTHLY REPORTS ON EMPLOYMENT IN RETAIL TRADE
BUREAU OF LABOR STATISTICS

Line of Trade	Census - 1929		B.L.S. Monthly Reports			
	No. of stores	No. of employees	No. of stores		No. of employees	
			Aug. 1933	Aug. 1934	Aug. 1933	Aug. 1934
TOTAL, ALL TYPES	1,543,158	4,510,140	17,461	59,820	361,164	858,010
FOODS	481,891	723,407	10,535	19,746	63,656	148,475
Groceries and meats	307,425	443,628	10,187	16,953	53,149	99,083
Milk dealers	3,990	53,965	171	970	8,523	35,944
Confectionery	63,265	62,609		551		5,534
Bakery goods	11,903	28,148	177	954	1,984	6,333
Other	95,308	135,057		318		1,581
AUTOMOTIVE	257,685	685,977	1,211	12,206	12,844	114,193
Motor vehicle dealers	45,301	356,579	457	2,893	8,030	50,324
Garages	66,793	120,129	191	1,083	1,856	9,457
Filling stations	121,513	150,521	243	7,118	1,649	45,750
Auto accessories	22,313	55,216	320	1,077	1,309	8,339
Other	1,765	3,532		35		323
GENERAL MERCHANDISE	54,636	827,776	1,372	4,749	220,363	322,852
Department stores	4,190	508,249	503	719	183,555	220,514
Variety stores	12,110	163,617	610	1,273	19,437	36,395
Dry goods and gen'l mdse	38,305	120,041	249	2,741	4,758	48,290
Mail order	31	35,869	10	16	12,613	17,653
APPAREL	114,296	404,130	1,008	5,379	18,912	66,475
Women's, incl. accessories	25,791	142,913	250	1,098	9,879	25,191
Millinery	12,433	24,878		309		1,341
Men's	28,197	85,269	162	984	3,312	12,067
Shoes	24,259	66,611	435	2,146	2,149	14,934
Family clothing	10,551	52,952		573		10,764
Custom tailors	11,284	26,095	161	129	3,572	1,013
Other	1,781	5,412		140		1,165
FURNITURE AND HOUSEHOLD	58,941	271,502	391	2,161	9,075	33,458
Furniture	25,153	127,275	267	1,629	6,372	25,941
Household appliances	8,931	56,471		151		1,896
Radio, electrical and music	16,037	55,853	124	281	2,703	3,198
Other	8,820	31,903		100		2,423
RESTAURANTS	134,293	477,776	-	3,561	-	56,952
LUMBER AND BLDG. MATERIALS	52,814	242,181	475	2,586	5,036	21,670
Lumber and bldg. materials	26,377	149,559	349	1,781	3,999	15,042
Electrical shops	4,858	16,043		164		1,572
Heating and plumbing	12,709	52,930	126	287	1,037	2,638
Paint and glass	8,870	23,649		302		1,698
Other	-	-		52		720
GENERAL STORES	104,089	137,954	80	196	937	2,031
OTHER RETAIL STORES	269,448	721,377	1,927	9,236	21,774	91,904
Cigars	33,248	34,238	128	597	659	2,339
Drugs	58,258	178,852	691	2,927	7,847	27,163
Hardware and farm impl	37,572	85,832		934		7,851
Feed stores	9,953	19,403		581		3,157
Jewelry	19,998	45,594	1,108	654	13,268	6,558
Coal, wood yards	15,444	80,705		1,727		21,243
Other	94,975	276,753		1,816		23,573
SECOND HAND STORES	15,065	18,060	-	-	-	
UNCLASSIFIED	-	-	462	-	8,567	-

important to note that the number of reports was substantially increased for these lines of trade for which data previously were inadequate or were not collected. Among the retail lines which were considerably improved are filling stations, automobile dealers, restaurants, chain stores, and stores selling drugs, hardware, shoes, furniture, etc. As a whole the sample is still not large, as compared with the very large number of retail shops in existence. A complete analysis can only be made, however, on the basis of returns from the Census of American Business of 1933, which will soon be completed.

Reports from these newly added firms were introduced into the published totals for wholesale and retail trade in June, 1934, although data are available for earlier months of 1934 and will later be utilized. Thus monthly fluctuation reflected in the index numbers will hereafter be more representative. However, the indexes as they are now published for the period since 1929 are not representative of current developments, and the Bureau of Labor Statistics contemplates a major revision which will greatly improve their quality. As now published they are relatives based on unweighted totals of employment and earnings for all lines of trade, without having proper weights by types of trade or by states. Thus monthly fluctuations in retail trade, for example, are misleading because of undue weight given to department stores, in which seasonal variations are much more extreme than in other and more important lines of trade. Neither is the trend of employment over a period of years properly represented. As checked against changes from 1929 to 1933 shown by the Census of Distribution of 1929 and the Census of American Business for 1933, the Bureau's indexes understate the decline in employment in both retail and wholesale trade as a whole by about 5 per cent.

These defects can be remedied in large part by the construction of revised index numbers for the entire period since 1929 embodying the following general features recommended by the Advisory Committee:

1. Use of weights by lines of trade, and, whenever geographical distribution is disproportionate, by states, derived from the Census of American Business of 1933.
2. Adjustment to trend from 1929–1933 by lines of trade, as shown by Census data.

In recognition of the desirability of weighting by lines of trade, the Bureau has already segregated reports for general merchandise stores from others and given each group a proportionate weight, thus reducing the effect of fluctuations in department store trade. This temporary revision has not been published, however, since the Bureau

prefers to wait until a thorough-going revision along these lines, now in process, can be completed.

CONSTRUCTION

Reports on employment in the construction industry were inaugurated by the Bureau of Labor Statistics late in 1930 for one city, but it was not until 1932 that reports began to be comprehensive enough to represent fluctuations in different parts of the country. At that time firms in 53 cities, canvassed directly by the Bureau, and in seven states covered by the coöperating agencies, were reporting. This coverage has been maintained to the present time. Eleven thousand firms were reporting in August, 1934. They represent employment in private and public construction of an architectural nature, not financed by PWA. Engineering work, such as roads and streets, bridges, dams, etc., is not included. The present sample is not inclusive enough to represent the construction industry as a whole. It is impossible to test the accuracy of the sample either for trend or for completeness of representation, in the absence of a comprehensive census enumeration of employment since 1929–30, when the construction industry was very much more active than at present. Even the Census of Construction and the statistics for the building industries given in the Census of Occupations are so unsatisfactory that it is difficult to obtain a reasonably representative estimate of employment for those years.

In the field of public construction two series have been available—employment on Federal and state highways, including maintenance, and on other types of Federal construction. The former has been collected by the Bureau of Public Roads since 1931, the latter by the Federal Employment Stabilization Board since July, 1932. No corresponding data on payrolls have been available until very recently.

Most complete reports for the construction industry are for employment on contracts and other work financed by funds from the Public Works Administration. Contract forms require reports to the Department of Labor giving a complete weekly record of number of employees, wages paid and total hours worked. An elaborate reporting system which obtains coverage that is practically complete was organized in coöperation with the Public Works Administration beginning in the autumn of 1933. Reports are made directly to the Bureau of Labor Statistics except for work on public roads, which is reported to the Bureau of Public Roads and published also by the Bureau of Labor Statistics. Employment is given both in the form of averages for the four or five-week period covered in the report, and of the largest number on the payroll in any week during the period. With the addition

in April, 1934, of reports from contractors whose work is financed by funds loaned by the Reconstruction Finance Corporation, the picture of employment in publicly-financed construction activity is practically complete. Since new public construction is now more important in volume than private construction, this is a very important part of the industry as a whole.

Unfortunately, however, no data are available on one increasingly important sector of the industry—repairs—because of the small and scattered nature of the jobs. Partly for this reason, but also because of the absence of satisfactory Census data which would make possible a properly weighted combination of all available current reports, no index numbers representing the industry as a whole have been constructed.

PUBLIC EMPLOYMENT

Employees of the Federal Government, which were counted only for the executive branches of the service prior to November, 1933, are now reported each month for the judicial and legislative services and for the armed forces. At the same time reports of total payrolls were inaugurated. In addition, the Federal emergency agencies such as the Civilian Conservation Corps, the Civil Works Administration and the Emergency Works Program conducted by the Federal Emergency Relief Administration also report the number of persons on their payrolls, and total earnings. The first is reported once a month, the latter weekly.

Thus it is possible to indicate each month the total number of persons on the regular Federal payroll and receiving pay through Federal emergency agencies, and such a report is available each month from the *Monthly Labor Review*.

For state and local governments no information is collected, except that for state roads mentioned above. The Bureau of Labor Statistics is now experimenting with schedules and with an organization to obtain data from local and state governments, and it is to be hoped that a reporting service will be initiated shortly.

FINANCIAL INSTITUTIONS

Since 1929 the Bureau of Labor Statistics has requested information on employment from four classes of trade and financial institutions—banks, brokerage houses, insurance companies and real estate offices. Reported employment for these four industries was grouped in an unweighted total for which relatives on a 1929 base were published. This procedure obscured both the adequacy of the sample and important differences in trend—the stability of employment in insurance and

marked declines in brokerage houses for example. Moreover, the use of a chain index which takes no account of firms suspending operations has so distorted these indexes that they are gravely misleading, especially in the case of banks. The thousands of bank suspensions since 1929 have not registered in the figures. Moreover the reported sample is inadequate except in the case of insurance companies. Less than 3,000 out of 15,000 commercial and savings banks were reporting in August, 1934; only 740 real estate firms, 380 brokerage houses.

On recommendation of the Advisory Committee, the index for the four series combined has been discontinued, and only monthly percentage changes are now being published. For banks, immediate improvement is possible through comparison with the survey of employment in commercial banks, recently issued by the Federal Deposit Insurance Corporation for June 30, 1934. Estimates of employment can probably be made for earlier years from related data, and the list of banks currently reporting greatly expanded. For insurance companies, for which reports are already fairly satisfactory, an index can probably be constructed, but for real estate companies, in view of the present small sample, it is essential that coverage be broadened if publication is to be continued.

OTHER INDUSTRIES

Data are also available for certain other industries, notably hotels, dyeing and cleaning establishments and power laundries, for all of which periodic Census data make possible a check on the coverage of the sample and the trend of employment.

For the vast bulk of the service occupations, however, for the hand trades, the professions and other occupations in which services are sold direct to the public, for many white-collar salaried workers, as well as for officers of corporations, and owners and proprietors of business, little or no information now exists. Nor is there any immediate prospect that an organization can be developed for its collection. Meantime, we can only urge more frequent Census reports to provide a cross-section of the employed population, and recognize that in the interim, estimates of total employment will contain a large element of error.

THE CHI-TEST AND CURVE FITTING

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INTRODUCTION

The Chi-test was designed [1] by its originator as a criterion for testing a proposed frequency distribution. Its acceptance and developments for this purpose are well known. It was not many years until E. Slutsky [2] suggested that the same criterion could be carried over to test the goodness of fit of an empirical formula. Some of Slutsky's illustrations were criticized by Karl Pearson [3] and later by Fisher,[4] but his paper, nevertheless, ranks as an invention in curve fitting. It is a fact that Slutsky pointed out in advance [5] some of the difficulties mentioned by Fisher.

Turning to Fisher's criticisms of Slutsky's deductions, we are able to realize now that Slutsky's failure to correct for the number of adjustable parameters in his formulas was a sin of omission rather than one of commission. In other words, he was testing not only the *form* of his functions but the constants in them as well,[6] if one is to judge by the wording of his conclusions; and for this purpose he required no correction. Whether or not he should have been testing *those particular constants* is another matter, and on this point there is room for criticism.

Slutsky in his illustrations omitted to test *merely the form* of his functions. His development of the χ^2 distribution does not make allowance for the fact that the parameters in a proposed function may be adjustable and not absolute. In fact at that time the distinction between the two hypotheses

(a) The *form* of the functional relation between x and y is $F(x, y; a, b) = 0$, the parameters a and b being unspecified, *i.e.*, having any values whatever;

(b) The *form* of the functional relation between x and y is $F(x, y; a, b) = 0$ *and* the parameters a and b have the values A and B respectively;

seems not to have been clearly recognized; neither were there any well-defined notions regarding statistical tests of hypotheses in relation to probabilities *a priori*.[6]

[1] Karl Pearson, *Phil. Mag.*, 50, pp. 157–175 (1900).
[2] E. Slutsky, *Journ. Roy. Stat. Soc.*, 77, pp. 78–84 (1913).
[3] Karl Pearson, *Biometrika*, 11, pp. 239–261 (1915–17).
[4] R. A. Fisher, *Journ. Roy. Stat. Soc.*, 85, pp. 597–612 (1922).
[5] See page 82 of Slutsky's paper mentioned in the second footnote.
[6] An enlightening discussion of this distinction will be found in three papers by J. Neyman and Egon S. Pearson, *Biometrika*, 20a, pp. 263–294 (1928); *Proc. Camb. Phil. Soc.*, 29, pp. 492–510 (1933); *Phil. Trans. Roy. Soc.*, 231A, pp. 289–337 (1933).

Chiefly through the efforts of Fisher we know now that the two hypotheses stated above are to be tested by the same table and the same χ^2, but with a different n (or n'), for the number of "degrees of freedom" is different for the two hypotheses. In testing (a), the number of degrees of freedom is the number of points fitted diminished by the number of independent adjustable parameters. In testing (b), the number of degrees of freedom is simply the number of points fitted. It is the latter hypothesis that Slutsky dealt with, but the proposed values A and B of the parameters were in his examples obtained from the fitted data. Since he had poor grounds *a priori* for thinking that his A and B were the true values of the parameters, his conclusions, though valid, were of little or no interest.

In the present paper it is proposed to develop the distribution of χ^2 as it appears in curve fitting, the assumption being from the start that the true values of the parameters are not known. The proper number of degrees of freedom will appear naturally, and not as the result of an artificial correction. A critical inspection of the assumptions underlying curve fitting will be made. A special feature will be allowance for errors of observation in both coördinates; in fact, extension to three or more coördinates will be obvious and require little comment. The paper will conclude with examples illustrating the use of χ^2 for deciding which of several formulas best fits a given set of data.

SOME GENERAL NOTIONS OF CURVE FITTING

It is important to realize just what is being done when a set of data in two variables is taken. For every "observed point" X, Y there is an unknown "true point" x_t, y_t. Furthermore, when the job of curve fitting is completed [7] there will be found a "calculated point" for each "observed point." The calculated points are estimates of the positions of the true points.

The calculated points will all lie on the "calculated curve"

$$F(x, y; a, b, \ldots) = 0, \tag{1}$$

and the true points will all lie on the "true curve"

$$F(x, y; \alpha, \beta, \ldots) = 0. \tag{2}$$

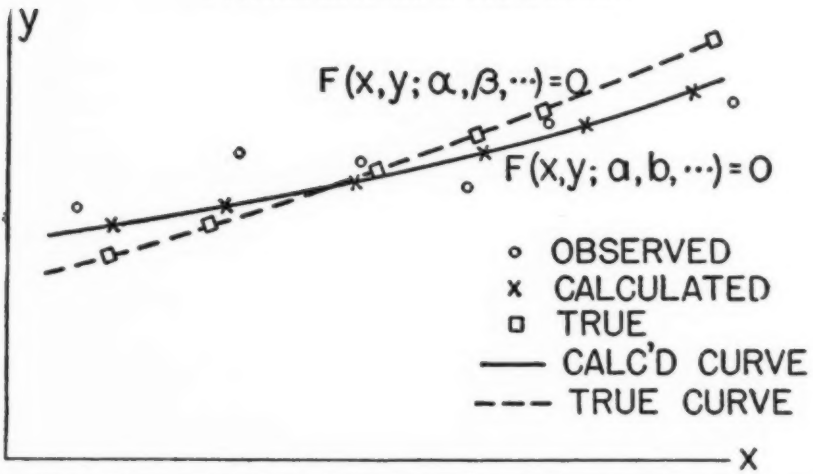
These equations have the same *form* but *different parameters;* $\alpha, \beta, \ldots$ are the *true* but unknown parameters in the *true* curve; $a, b, \ldots$ are

[7] It is customary to consider that a job of curve fitting has been finished when estimates for the parameters have been obtained. But in the method of least squares it is a simple matter to go ahead and determine also the "residuals" and the "calculated points," *i.e.*, to *adjust the observations.* The complete solution to the general problem, under the assumption that the residuals are all small, is given by the author in the *Phil. Mag.*, xi, pp. 146–158 (1931); xvii, pp. 804–829 (1934).

the *calculated* parameters in the *calculated* curve. The situation is shown graphically by Chart I.

CHART I

A TYPICAL SITUATION IN CURVE FITTING



It is assumed that the "true points," wherever they are, lie on the "true curve" $F(x, y; \alpha, \beta, \ldots) = 0, \alpha, \beta, \ldots$ being the true and unknown values of the parameters. The "calculated points" lie on the "calculated curve" $F(x, y; a, b, \ldots) = 0, a, b, \ldots$ being the calculated (estimated) values of the parameters. The calculated points are estimates of the true points.

The form of the function to be fitted, whether it be empirical or rational, is tentatively assumed to be correct. In the end, it will be retained, rejected, or placed under suspicion depending on how well it fits the data. The Chi-test provides a quantitative criterion for judgment and comparison.

The relations between the x and y residuals and errors at any point is shown in Chart II, and can be expressed analytically by the equations

$$\left.\begin{aligned} E_x &= V_x + U_x \\ E_y &= V_y + Y_y \end{aligned}\right\} \tag{3}$$

Of these six quantities at any point, only V_x and V_y can be found.

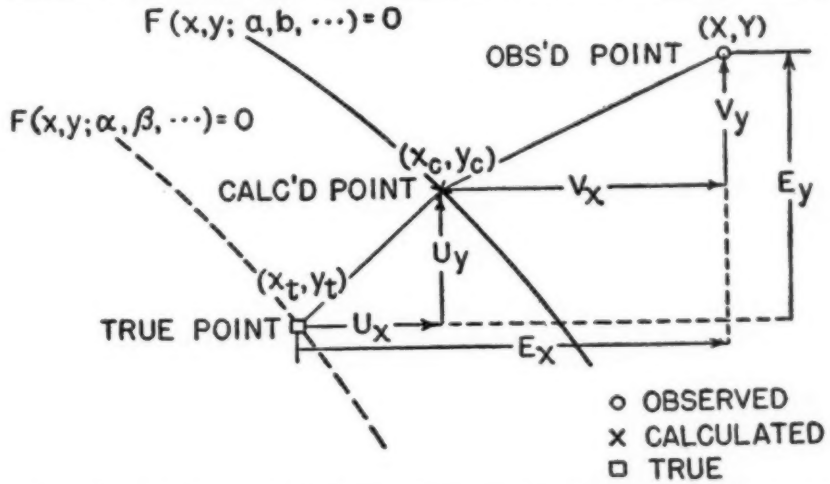
THE PROBABILITY OF THE ERRORS OF THE OBSERVED POINTS

It is desirable to consider first of all a single observed point, and to write down the probability associated with small ranges of E_x and E_y. On the basis of the normal law of error, the probability that the errors in X and Y will lie respectively in the intervals $E_x \pm \frac{1}{2}dE_x$ and $E_y \pm \frac{1}{2}dE_y$ is [8]

[8] In this paper, probability curves and surfaces will be written in differential form, and D will be used indiscriminately for the ordinates of all of them. The quantities under the differentials specify the

CHART II

RELATIONS BETWEEN THE "TRUE," "OBSERVED," AND "CALCULATED" POINTS



The x and y coördinates of a point are observed; these observations when plotted give the "observed point." The point that was measured is the "true point," which is unknown and lies on the unknown "true curve" $F(x, y; \alpha, \beta, \ldots) = 0$. $\alpha, \beta, \ldots$ are the true but unknown values of the parameters. The "calculated curve" is found by adjusting a series of observed points; its equation will have the same form as the true curve, but the parameters therein will be the "calculated parameters" $a, b, \ldots$. Corresponding to each observed point there will be a "calculated point," whose coördinates are found by subtracting the "residuals" V_x and V_y from the observed coördinates X and Y. E_x and E_y denote the "errors in the observed point"; U_x and U_y denote the "errors in the calculated point." E_x, E_y, U_x, and U_y are unknown, but V_x and V_y are calculated along with the parameters $a, b, \ldots$ by the method of least squares. As the figure happens to be drawn, each of the six quantities E_x, E_y, U_x, U_y, V_x, V_y is positive. Their signs are indicated by the directions of the arrows.

$$D\,dE_x\,dE_y = \left[\frac{\sqrt{w_x}}{\sigma\sqrt{(2\pi)}}e^{-w_xE_x^2/2\sigma^2}\,dE_x\right]\left[\frac{\sqrt{w_y}}{\sigma\sqrt{(2\pi)}}e^{-w_yE_y^2/2\sigma^2}\,dE_y\right] \quad (4)$$

Here w_x and w_y are the weights of X and Y; σ is the root mean square error of observations of unit weight. σ is arbitrary to the extent that the weights are arbitrary—though σ is arbitrary, w_x/σ^2 and w_y/σ^2 are not.

This disposes of the errors at a single point. The situation at the other points in the problem will be similar, but entirely independent of one another. If there are n points in all, then the probability of the simultaneous occurrence of errors in the $2n$ intervals $E_{x1} \pm \frac{1}{2}dE_{x1}$, $E_{x2} \pm \frac{1}{2}\,dE_{x2}$, . . . , $E_{yn} \pm \frac{1}{2}\,dE_{yn}$ is

$$DdE_{x1} \ldots dE_{yn} = const.\ exp\ [-(1/2\sigma^2)\ \Sigma\ (w_xE_x^2 + w_yE_y^2)]\ dE_{x1} \ldots dE_{yn} \quad (5)$$

ranges that are covered, and the whole expression represents the probability within those ranges. Thus, in Equation (4), $D\,dE_x\,dE_y$ is the probability that the errors in X and Y (the observations) lie within $E_x \pm \frac{1}{2}dE_x$ and $E_y \pm \frac{1}{2}dE_y$.

This comes from taking the product of n factors like the one in the preceding equation. The constant factor in the last equation can be written out if desired, but it is not needed; it is the product of n factors like $w_x^{\frac{1}{2}}\, w_y^{\frac{1}{2}}/2\pi\sigma^2$. The parenthesis following the summation is to be summed over all n points.

THE TRANSFORMATION TO RESIDUALS

The exponential just written in Equation (5) is in terms of the true but unknown errors of the observed points. The whole expression must be put in terms of the known residuals if we are to develop a distribution of χ^2 that will allow for the adjustable parameters in the formula.

The right-hand side of Equation (5) consists of two parts, the exponential and the differentials. Both of these must be transformed.

A pair of equations like Equation (3) exists at every one of the n points. We may therefore write

$$\left.\begin{aligned} E_{xi} &= V_{xi} + U_{xi} \\ E_{yi} &= V_{yi} + U_{yi} \end{aligned}\right\} \qquad i = 1, 2, \ldots, n \tag{6}$$

On the left there are $2n$ independent variables. On the right there are $4n$ variables, but only $2n$ of them are independent; the next step is to find out how few of the residuals (V_x and V_y) may be considered independent.

For ease in expression, and hence for clarity, it will be well to restrict the discussion for a moment to some small number of points and a small number of parameters. It will be easy enough to generalize later. Suppose, then, that we have five observed points and two parameters; n will be 5, and p, the number of parameters, will be 2.

Starting with five true points chosen at will on the true curve, we may lay off from two of them, say No. 4 and No. 5, the arbitrary distances U_{x4} and U_{x5} in the x direction and U_{y4} and U_{y5} in the y direction. These two pairs of arbitrary distances (errors in the calculated points) will, when thus laid off, determine two calculated points. Now the calculated curve must pass through these points; hence, since there are only two parameters in the empirical formula, the calculated curve is unambiguously fixed by the two calculated points. The other calculated points must lie on the same curve; wherefore of the remaining six errors U_{x1}, U_{x2} U_{x3}, U_{y1}, U_{y2}, U_{y3}, only three can be chosen at will. For suppose that we arbitrarily select U_{y1}, U_{y2}, and U_{y3} and lay them off in the y direction from the true points No. 1, 2, and 3; the corresponding x components U_{x1}, U_{x2}, U_{x3} can *not* be chosen at will, because they are just the distances required

to complete the location of three more points *on the calculated curve,* which has already been fixed. So if the seven quantities

$$U_{x4},\ U_{x5},\ U_{y1},\ Y_{y2},\ U_{y3},\ U_{y4},\ U_{y5}$$

have been chosen arbitrarily, the entire five calculated points are located.

There are three more arbitrary quantities on the right of Equations (6), since there must be ten in all. For the remaining three we may take

$$V_{x1},\ V_{x2},\ V_{3x};$$

these will automatically determine the corresponding y residuals [9] V_{y1}, V_{y2}, V_{y3}, and hence will determine three of the observed points. The coördinates of the remaining two observed points can be found from the two normal equations, since the two parameters have already been fixed. Thus, by choosing the ten quantities

$$V_{x1},\ V_{x2},\ V_{x3},\ U_{x4},\ U_{x5},\ U_{y1},\ \ldots,\ U_{y5}$$

the five calculated points and the five observed points have been located. These ten quantities will be the ten independent variables on the right of the five pairs of Equations (6).

It is easy to extend the argument to any number of points and any number of parameters. The number of independent residuals is always found to be $n-p$. It will be convenient to denote $n-p$ by the letter k, which will be the "number of degrees of freedom" in the problem.

By multiplying Equations (6) through by w_{xi} and w_{yi} respectively, then squaring each member and adding, it is not difficult to see that

$$\Sigma(w_xE_x^2+w_yE_y^2)=\Sigma(w_xV_x^2+w_yV_y^2)+2\Sigma(w_xU_xV_x+w_yU_yV_y)+\Sigma(w_xU_x^2+w_yU_y^2) \tag{7}$$

This puts the exponential of Equation (5) in terms of the residuals.

THE DISTRIBUTION OF χ^2

Now if

$$\phi\equiv\Sigma(w_xV_x^2+w_yV_y^2) \tag{8}$$

and if

$$\chi^2\equiv\phi/\sigma^2=(1/\sigma^2)\ \Sigma(w_xV_x^2+w_yV_y^2) \tag{9}$$

[9] The x and y residuals at any point are not independent but are related by the equation $V_x/V_y=-(w_y/w_x)(dy/dx)$, dy/dx being the slope of the curve at the given point. In particular, if $w_x=w_y$, i.e. if the x and y coördinates at any point are of equal weight, the line joining the observed and calculated points will be perpendicular to the empirical curve.

then Equation (5) transformed from the variables on the left of Equations (6) to the independent ones on the right will give

$$D\,dV_{x1}\ldots dV_{xk}\,dU = const.\;J\,exp\,[-\tfrac{1}{2}\chi^2+(2/\sigma^2)\,\Sigma(w_xU_xV_x+w_yU_yV_y) +(1/\sigma^2)\,\Sigma(w_xU_x^2+w_yU_y^2)]\,dV_{x1}\ldots dV_{xk}\,dU \qquad (10)$$

for the probability that k of the x residuals lie in the intervals $V_{xi}\pm\frac{1}{2}dV_{xi}$ $(i=1, 2, \ldots, k)$ *and* that the $2n-k$ independent errors in the calculated points lie also in $2n-k$ specified differential intervals. dU is here written for $dU_{x,k+1}\,dU_{x,k+2}\ldots dU_{xn}\,dU_{y1}\,dU_{y2}\ldots dU_{yn}$. J is the Jacobian of the transformation and transforms elements of "volume" from one set of variables to the other. It will be a function of the parameters and will be absorbed into the constant multiplier, hence it need not be evaluated.

It is a fact that when the parameters have been *fitted by least squares, i.e. if* χ^2 has been made a minimum,

$$\Sigma(w_xU_xV_x+w_yU_yV_y)$$

vanishes[10] to within higher powers of U_x and U_y. This is important, for it means that the middle term of the exponential in the last equation drops out. The result of integrating the right-hand side with respect to the U's from $-\infty$ to $+\infty$ is then simply

$$D\,dV_{x1}\ldots dV_{xk} = const.\;e^{-\frac{1}{2}\chi^2}dV_{x1}\ldots dV_{xk}. \qquad (11)$$

This gives the probability that k of the x residuals lie in the aforementioned intervals, while the $2n-k$ errors $U_{x,k+1}\ldots U_{yn}$ of the calculated points remain unspecified, *i.e.*, lie anywhere between $-\infty$ and $+\infty$.

If the middle term of the exponential in Equation (10) were not negligible, low powers of the residuals would have appeared in Equation (11) extraneous to χ^2, with the result that the distribution of χ^2 would be considerably disturbed.

By Karl Pearson's geometrical reasoning[1] it is not difficult to show that Equation (11) leads to

$$D\,d\chi^2 = \frac{1}{\Gamma(\frac{1}{2}k)2^{\frac{1}{2}k}}(\chi^2)^{\frac{1}{2}(k-2)}e^{-\frac{1}{2}\chi^2}d\chi^2 \qquad (12)$$

for the distribution of χ^2. Here

$$k=n-p, \qquad (13)$$

the number of points diminished by the number of adjustable parameters.

[10] W. Edwards Deming, *Phil. Mag.*, 19 (1935), to appear.

The summation in the parenthesis for the definition of χ^2 in Equation (9) is to be taken over all points. If at any point only the x coördinate is subject to error then the y term $w_y V_y^2$ is zero and contributes nothing to χ^2. The distribution of χ^2 has evidently not been affected by allowing both coördinates to have error; neither would it be affected if each point had a third measured coördinate. The only difference comes in the contributions to χ^2 itself, not in its distribution. In line with this it is interesting to note also that once the matrix from which the normal equations are to be derived has been set up, the process of applying least squares for estimating the parameters and adjusting the observations, also the calculation of the root mean square errors of the parameters, is unaffected by the number of coördinates subject to error.[11]

ϕ *can* be calculated from its definition, Equation (8), after the residuals V_x and V_y at all points have been computed, but in practice this method can often be avoided; for example, when the correlation is high, as it usually is in physical and engineering problems, ϕ would be calculated by a simple extension of a systematic solution of the normal equations.[12] In the special case of a line fitted to points of equal weight, we have from well known formulas in statistics,

$$\phi = n(1-r^2)S_y^2, \text{ (x free from error, all y coördinates of equal weight).}$$
$$\phi = n(1-r^2)S_x^2, \text{ (y free from error, all x coördinates of equal weight).}$$
$$\phi = \tfrac{1}{2}n[(S_x^2+S_y^2) - \sqrt{(S_x^2-S_y^2)^2+4r^2S_x^2S_y^2}]^{\frac{1}{2}}, \text{ (x and y coördinates all of equal weight).} \qquad (14)$$

S_x and S_y being the standard deviations of the x and y coördinates about the centroid, and r the coefficient of correlation between x and y derived from the fitted points.

Whereas ϕ can always be computed if least squares is possible [13]—which is to say, if the weights of the observed coördinates are known—χ^2 can not be calculated unless σ (the root mean square error of observations of unit weight) is known. Once σ is known, χ^2 comes immediately by dividing ϕ by σ^2, Equation (11).

EXAMPLES OF THE USE OF χ^2 FOR ESTIMATING σ

It is well known that because of the shape of the χ^2 curve [Equation (12)], the mean value of χ^2/k is unity. It is, moreover, not difficult

[11] Charles H. Kummell, *The Analyst* (Des Moines), 6, pp. 97–105 (1879). See also the references in footnote 7.

[12] The method referred to for computing ϕ is the same as the one for computing $\Sigma vv'$ given in Art. 147 of O. M. Leland's *Practical Least Squares* (McGraw-Hill, 1921). See also the forthcoming paper mentioned in footnote 10.

[13] A curve can not be fitted by least squares unless the weights of the coördinates of all points are assigned.

to show that the *optimum* value of σ in the distribution of ϕ/σ^2 is that which renders χ^2/k equal to unity. Hence to get an estimate of σ based on the fit of the curve (based on "external consistency," Birge[14] would say) we may simply *assume* that $\chi^2/k=1$.[15] This is the same as saying that

$$\sigma_s^2=\frac{\Sigma(w_xV_x^2+w_yV_y^2)}{n-p}, \tag{15}$$

as comes easily by rearranging Equation (9) and replacing k by $n-p$. The subscript s connotes that the quantity to which it is attached is merely an *estimate* made from a sample of some description. With the estimate of σ just given, it follows at once that the corresponding estimate of the root mean square error of an observation of weight w will be

$$\sigma_s(w)=\left[\frac{\Sigma(w_xV_x^2+w_yV_y^2)}{(n-p)w}\right]^{\frac{1}{2}} \tag{16}$$

This, of course, reduces to the preceding formula when $w=1$.

When only y is subject to error, these equations reduce to the usual ones found in textbooks and generally called "formulas for the root mean square error" of observations of unit weight and of weight w respectively. This designation is clearly a misnomer, for such formulas, like Equations (15) and (16), only give *estimates* of the root mean square errors. χ^2/k can vary all the way from 0 to ∞, so it is only an *assumption* to equate χ^2/k to its average value, unity. What we should *like* to have, but usually in economics do *not* have, is a fairly reliable value of σ based on prior data, so that not only ϕ but χ^2 also can be computed. In such a situation, with χ^2 and k known, the Chi-tables would give the probability that the value of χ^2 actually obtained could be exceeded purely by chance; in other words, we then hav a test for the goodness of fit of the formula.

When σ is not known *a priori*, we do not have a test for the goodness of fit of a single formula, but by the artifice of *assuming* that $\chi^2/k=1$ we can compare one formula with another, when they have been fitted to the *same data* with the *same weighting*.

As a simple example we may turn to Figure 5 on page 37 of Henry Schultz's *Statistical Laws of Demand and Supply* (University of Chicago, 1928). We see there three distinct lines, fitted by least squares under three different assumptions regarding the weights of the coördinates of the 24 points.

[14] Raymond T. Birge, *Physical Review*, 40, pp. 207–261 (1932).

[15] This assumption is almost, but not exactly, the same as equating $P(\chi^2)$ to ½. The difference lies in the fact that the mean and median of the χ^2 curves [Equation (12)] do not coincide.

For line A it is assumed that the x coödinates are free from error and that the y coördinates all have unit weight.
For line A' it is assumed that the y coördinates are free from error and that the x coördinates all have unit weight.
For line N it is assumed that all x and y coördinates have unit weight.

On page 43, Professor Schultz gives the following figures:

For line A, $\Sigma w_y V_y^2/24=\Sigma V_y^2/24=0.0708^2$, $\Sigma w_x V_x^2=0$;
For line A', $\Sigma w_x V_x^2/24=\Sigma V_x^2/24=0.0461^2$, $\Sigma w_y V_y^2=0$;
For line N, $\Sigma(w_x V_x^2+w_y V_y^2)/24=\Sigma(V_x^2+V_y^2)/24=\Sigma\ (normals)^2/24=0.0413^2$.

Here $n=24$ and $p=2$. So from these figures we deduce immediately that the estimated root mean square error of a single point (an observation of unit weight)

$$\begin{aligned} \text{For line } A \text{ is } \sigma_s &= 0.0708\sqrt{24/22} \\ A' \text{ is } \sigma_s &= 0.0461\sqrt{24/22} \\ N \text{ is } \sigma_s &= 0.0413\sqrt{24/22} \end{aligned}$$

These, as Schultz concludes on other considerations, do *not tell which line really fits best.* Such a question can not be answered. Each line is the best possible line for the assumptions on which it was fitted, since each was fitted by least squares. All we can say is that none of the three figures just listed for σ_s looks impossibly large.

The situation is different, however, when for the *same assumptions* we have several *different functions* fitted by least squares to a set of points. An illustration may be drawn from Figure 8 on page 51 of the same book by Schultz. There we find six curves fitted to 26 points. For simplicity I shall call the axes x and y; then the assumptions are that the x coördinates are free from error and that the y coördinates have equal weight. $\Sigma(w_x V_x^2+w_y V_y^2)$ can then be conveniently contracted to $\Sigma\ v^2$. Schultz gives $\Sigma\ v^2$ for the six curves, at the bottom of page 52. It is well to ignore here the sixth of these curves, the Rhodes curve, since it is not easily discussed on the same terms as the other five. We then make up the following tabulation for the five curves to be compared with one another.

Curve	$\Sigma\ v^2$	p	$n-p$	$\sigma_s^2=\Sigma v^2/(n-p)$
Line	4.681	2	24	$0.195(1\pm0.29)$
Quadratic	4.630	3	23	$.201(1\pm0.29)$
Cubic	3.681	4	22	$.167(1\pm0.30)$
Quartic	3.149	5	21	$.150(1\pm0.31)$
Quintic	1.959	6	20	$.098(1\pm0.32)$

The fraction standing after the double sign in the σ_s^2 column is the estimated proportional root mean square error[16] in σ_s^2, being $[2/(n-p)]^{\frac{1}{2}}$.

On the basis of the last column, it is probably safe to say that the quintic seems to give the best fit. Whether or not a sixth degree curve would be still better is problematical. It is interesting to note that on the basis of the last column, the quadratic actually gives a worse fit than the line, though of course Σv^2 is less for the quadratic. It is also interesting to observe that there is little choice between cubic and quartic, but that the quintic is definitely better than the quartic. Schultz properly had other considerations for making his selection. It is possible, though, that a comparison of the estimated root mean square error of unit weight (σ_s) might advantageously be included among the statisticians' criteria for choosing which function is the best to use.

In this example, the error was all in y, but the procedure is the same when both coördinates are subject to error, except that $\Sigma(w_x V_x^2 + w_y V_y^2)$ must replace Σv^2.

SUMMARY

A critical inspection of the fundamentals of curve fitting has been made. It is found that to each observed point there corresponds a calculated point and an unknown true point. The calculated points lie on the fitted curve, and the true points lie on an unknown true curve. By setting up the probability equation (based on the normal law) it is found that the distribution of χ^2 is unaffected by the number of observed coördinates at any point, but that only the value of χ^2 is affected by the number of observed coördinates at any point. It is found by a new approach to the problem that the number of degrees of freedom k is $n-p$, n being the number of points and p the number of independent adjustable parameters. By the artifice of setting χ^2/k equal to unity, an estimate of the root mean square error of unit weight is obtained. This estimate permits a comparison of several formulas fitted to the same data, as is illustrated by a simple example.

[16] W. Edwards Deming and Raymond T. Birge, *Reviews of Modern Physics*, 6, pp. 119–161 (1934).

VALUE OF THE GROSS NATIONAL PRODUCT AND ITS COMPONENTS, 1919–1929

By Clark Warburton

The preliminary results of an investigation of the value of the gross national product during the period 1919–1929 are presented in the accompanying tables. The final products which collectively were assumed to constitute the gross national product included both consumers' goods and services and new capital goods.

The consumers' goods and services taken into consideration included not only purchases by residents of the United States, but also goods and services provided gratis by governments and other agencies, food produced on farms or in garden plots and used at home, and the rental value of homes occupied by their owners. Services of housewives were not evaluated, nor was allowance made for the use-value of durable consumption goods other than homes.

Capital goods included new structures and equipment, changes in inventories and changes in the net amount of investments abroad. No allowance was made for the depreciation of structures and equipment in use.

Consumers' goods and services were evaluated at the point of transfer from producers or dealers to consumers; capital goods at the cost to the business enterprises acquiring them. Two methods were used in estimating the value of the gross national product: (1) final products were itemized and evaluated, chiefly from Census and trade data;[1] and (2) an analysis was made of the total amount and disposition of income and other funds available for purchasing final products.

The year 1929 was chosen for itemizing and evaluating final products in detail, because more data were available than for any other year. These estimates are summarized in Table I. Various methods of evaluation were used. The values of many of the food items, for example, were computed from estimated quantities consumed and estimated average retail prices. The values of most manufactured items were estimated from the value of products reported by the Census of Manufactures, allowance being made for foreign trade, sales to industrial consumers and trade margins. Whenever possible estimates were obtained in various ways and compared. For some items the estimates

[1] These estimates were prepared for the investigation of the Brookings Institution entitled, "The Distribution of Wealth and Income in Relation to Economic Progress," and the author is indebted to the Institution for permission to publish the results. In making these estimates, the author was assisted by Nathanael H. Engle, Chester B. Pond and Vladimir K. Kolesnikoff.

TABLE I

COMPOSITION AND VALUE OF THE GROSS NATIONAL PRODUCT, 1929

(Based chiefly on census and trade data)

A. Consumers' goods and services	*Millions of dollars*
Food and non-alcoholic beverages	*20,055*
Meat	4,422
Dairy products	4,195
Other proteins and fats	2,772
Cereals and bakery products	2,626
Vegetables, fruits and nuts	3,220
Sugar, confectionery, condiments and non-alcoholic beverages	3,056
Adjustment for industrial use and preparation of meals	−237
Shelter and home maintenance	*22,356*
Rent paid for rented non-farm homes	4,829
Rental value of owned non-farm homes	6,338
Rental value of farm homes	708
Room rentals and furnished quarters	1,206
Home equipment and decoration	4,702
Household supplies and operation	4,573
Attire	*13,669*
Men's and youths' clothing ready-to-wear	3,400
Women's and misses' clothing ready-to-wear	4,706
Children's and infants' clothing	476
Clothing materials and making	2,272
Jewelry and other articles of apparel	730
Care of clothing and apparel	958
Personal care	1,127
Other consumers' goods and services	*20,237*
Transportation	8,122
Communication	935
Health and medical care	3,556
Protective and civil services	1,652
Education and reading matter	3,626
Social organizations	1,458
Recreation and art goods	3,658
Stimulants	6,230
Total consumers' goods and services	85,317
B. Capital goods	
Structures and equipment	*17,442*
Residential buildings	3,508
Commercial and industrial buildings	2,104
Public and semi-public buildings	960
Highways and streets	1,333
Other transportation structures	1,106
Public utility structures	1,649
Machinery and equipment	5,748
Miscellaneous public works, buildings, agricultural improvements and engineering construction	1,034
Increase in inventories	*571*
Increase in investment abroad	*221*
Total capital goods	18,234
Total gross national product	103,551

are necessarily crude on account of the paucity of data. In a few cases —notably in regard to the operation of motor cars, transportation of passengers by common carriers, military and police protection, and the administration of government—it was necessary to make arbitrary assumptions as to the proportions of the estimated total values properly assignable to consumers' goods and services.

Estimates of the value of final products for the years 1919, 1921, 1923, 1925 and 1927, shown in Table II, were made by applying to the 1929 values group index numbers especially prepared for the purpose.[1]

[1] These index numbers were prepared by Mr. Kolesnikoff.

TABLE II

VALUE OF THE GROSS NATIONAL PRODUCT, 1919–1929 *
(Millions of dollars)

A. Consumers' goods and services

	1929	1927	1925	1923	1921	1919
Food and non-alcoholic beverages	20,055	19,413	18,731	16,626	15,151	19,654
Shelter and home maintenance	22,356	22,515	23,123	21,900	19,744	15,671
Attire	13,669	13,046	12,714	13,153	10,001	12,367
Transportation	8,122	7,123	6,928	6,051	4,646	4,475
Communication	935	789	748	659	546	539
Health and medical care	3,556	3,179	2,788	2,503	2,059	2,123
Protective and civil services	1,652	1,396	1,297	1,259	1,166	1,092
Education and reading matter	3,626	3,234	2,883	2,524	1,733	1,410
Social organisations	1,458	1,411	1,449	1,353	1,441	1,308
Recreation and art goods	3,658	2,831	2,392	2,016	1,478	1,010
Stimulants	6,230	5,227	5,227	5,183	2,585	3,034
Total consumers' goods and services †	85,317	79,997	77,704	71,918	61,479	60,003

B. Capital goods

	1929	1927	1925	1923	1921	1919
Structures and equipment	17,442	16,941	16,866	13,840	8,324	10,872
Changes in inventories	571	156	3,164	2,784	−4,469	6,819
Change in foreign investment	221	405	520	−21	875	2,236
Total capital goods	18,234	17,502	20,550	16,603	4,730	19,927
Value of gross national product—all items	103,551	97,499	98,254	88,521	66,209	79,930

* Figures for 1929 built up from detailed items. Estimates for other years based on index numbers especially prepared for this purpose.

† Except for 1929 the sum of the consumers' goods and services as itemized does not exactly equal the figure given for the total. This is because adjustments have been made in the total which cannot be made in the separate items.

Table III is a first approximation to a measurement of the flow of income and other funds available for purchasing final products. This

TABLE III

TOTAL AMOUNT OF FUNDS AVAILABLE FOR PURCHASING FINAL PRODUCTS, 1919–1929
(Preliminary estimates—millions of dollars)

	1929	1927	1925	1923	1921	1919
Aggregate income of individuals *	92,950	86,874	83,712	73,193	61,089	64,701
Institutional income †	9,004	7,265	8,285	7,196	−314	7,123
Business allowances ‡	9,204	8,529	7,893	7,228	6,603	6,375
Insurance benefits §	2,127	1,685	1,374	1,203	951	887
Credit expansion ‖	−28	525	1,751	1,177	−2,583	2,999
Total	113,257	104,878	103,015	89,997	65,746	82,085

* Figure for 1929 from Maurice Leven, *America's Capacity to Consume*, p. 206. Estimates for other years based on the King-Leven estimates of national income and on capital gains as reported in *Statistics of Income*.

† Includes corporate surplus, income of endowed institutions, and governmental revenue drawn from business enterprises but used in providing services to persons or for capital purposes.

‡ Includes depreciation and depletion allowances, and crude allowances for bad debts in retail accounts and for goods and services furnished free to employees and customers but not included in individual incomes.

§ Payments to policyholders by insurance companies.

‖ Change in outstanding volume of means of payment.

flow includes not only what is usually called the national income, but also such items as capital gains, business depreciation and depletion allowances, insurance benefits, and government revenue drawn from business enterprises but used in providing services to persons or for capital purposes.

The aggregate amounts spent by families and unattached individuals for major purposes—food, home, attire, other living, and savings—have been estimated from (a) frequency distributions of income among families and unattached individuals, and (b) average amounts spent for each of the major purposes by families and unattached individuals in the various income classes, as indicated by surveys of family expenditures. These estimates for 1929 have been published in *America's Capacity to Consume*.[1] For the remaining years estimates of the aggregate income received by the various income classes were prepared on the basis of income tax returns and Mr. Leven's estimates for 1929. The proportions of income spent for each of the major purposes by families and unattached individuals in the various income classes were assumed to have remained unchanged throughout the period.[2]

Amounts spent by states and by cities of more than 30,000 population for services to persons and for capital purposes were estimated from Census data. These estimates were supplemented by a special classification of Federal government expenditures, and by estimates of expenditures of local governments (excluding cities of more than 30,000 population) based on data from eight states. It was assumed that corporate surplus, business depreciation and depletion allowances, and funds obtained by credit expansion were used for capital purposes. Insurance benefits were assumed to have been spent for the five major purposes in accordance with the use of the aggregate income of individuals.

The aggregate amounts thus estimated to have been spent for each of the five major purposes are given in Table IV, and compared with the estimated value of final products in corresponding categories. In making this comparison it was necessary to make allowance for the direct return to the income stream, without having been spent for final products, of a part of the aggregate savings.

In view of the necessary crudity of many of the evaluations, and of the difficulty of classifying uniformly data drawn from Census and

[1] Leven, Moulton and Warburton, *America's Capacity to Consume* (The Brookings Institution, 1934), Appendix B.

[2] It should be observed that the surveys of family expenditures used as the basis of estimates of the use of income by families in 1929 were made at various dates from 1918 to 1930, inclusive. For this reason the estimates of the amounts spent in 1929 for major purposes by families in the various income classes are as representative of this entire period as they are of 1929. See Appendix B, *America's Capacity to Consume*.

TABLE IV

COMPARISON OF AMOUNTS SPENT FOR MAJOR PURPOSES BY FAMILIES, UNATTACHED INDIVIDUALS AND GROUPS AS ESTIMATED FROM SURVEYS OF FAMILY EXPENDITURES AND SUPPLEMENTARY DATA WITH THE VALUE OF FINAL PRODUCTS AS ESTIMATED FROM CENSUS AND TRADE DATA *

(Billions of dollars)

	1929	1927	1925	1923	1921	1919
Food and non-alcoholic beverages						
Spent by families, etc.	21.1	20.9	20.6	19.7	16.8	16.6
Value of final products	20.1	19.4	18.7	16.6	15.2	19.7
Shelter and home maintenance						
Spent by families, etc.	22.5	21.6	21.0	19.0	16.1	16.5
Value of final products	22.4	22.5	23.1	21.9	19.7	15.7
Attire						
Spent by families, etc.	11.6	11.2	10.9	10.0	8.5	8.7
Value of final products	13.7	13.0	12.7	13.2	10.0	12.4
Other living						
Spent by families, etc.	27.8	25.7	24.5	20.8	16.5	17.4
Value of final products	29.2	25.2	23.7	21.5	15.7	15.0
All consumers' goods and services						
Spent by families, etc.	83.0	79.4	77.0	69.5	57.9	59.2
Value of final products	85.3	80.0	77.7	71.9	61.5	60.0
Savings and capital items						
Savings of families, etc. †	30.4	25.5	26.1	20.4	7.8	22.8
Returned to income stream ‡	11.2	7.5	7.5	3.0	1.5	2.5
Net aggregate savings	19.2	18.0	18.6	17.4	6.3	20.3
Value of final products (capital goods)	18.2	17.5	20.6	16.6	4.7	19.9
Totals						
Total income and supplementary funds	113.3	104.9	103.0	90.0	65.7	82.1
Net amount available for purchasing final products §	102.1	97.4	95.5	87.0	64.2	79.6
Value of final products	103.6	97.5	98.3	88.5	66.2	79.9

* Amounts spent by families, etc., estimated from surveys of family expenditures (for method, see Appendix B, *America's Capacity to Consume*), supplemented by estimated expenditures of governments for services to persons and for capital purposes, expenditures of endowed institutions and business enterprises for capital purposes and for consumers' goods and services, use made of insurance benefits, etc. Value of final products estimated from Census and trade sources.

† Includes savings of families and unattached individuals, corporate surplus, business depreciation and depletion allowances, governmental expenditures for capital purposes, and credit expansion.

‡ Capital gains, insurance benefits, fraudulent securities and commissions on sales of property.

§ Total income and supplementary funds (see Table III) minus amount returned directly to the income stream.

trade sources and those derived from surveys of family expenditures, there is a remarkably close agreement between the two sets of estimates. The estimates derived from Census and trade data are considered by the author to be more reliable than those derived from the amount and use of income and supplementary funds.

In Table V the estimates of the value of final products have been reduced to a per capita basis, in order to bring out more clearly the significance of changes occurring during the period under consideration.

Perhaps a word may be added in regard to the relation of the value of the gross national product, as estimated here, to the national income, as estimated by King, Kuznets and others. The former is considerably larger than the latter. This difference is due chiefly to the inclusion, in

TABLE V

VALUE OF FINAL PRODUCTS PER CAPITA, 1919–1929

(Derived from Table II)

A. Consumers' goods and services

	1929	1927	1925	1923	1921	1919
Food and non-alcoholic beverages	$165	$164	$163	$149	$140	$187
Shelter and home maintenance	184	190	201	196	182	149
Attire	112	110	111	118	92	118
Transportation	67	60	60	54	43	43
Communication	8	7	7	6	5	5
Health and medical care	29	27	24	22	19	20
Protective and civil services	14	12	11	11	11	10
Education and reading matter	30	27	25	23	16	13
Social organizations	12	12	13	12	13	12
Recreation and art goods	30	24	21	18	14	10
Stimulants	51	44	46	46	24	29
All consumers' goods and services	$702	$677	$676	$645	$568	$571

B. Capital goods

Structures and equipment	$144	$143	$147	$124	$77	$104
Change in inventories	5	1	28	25	−41	65
Change in foreign investment	2	3	5	*	8	21
All capital items	$150	$148	$179	$149	$44	$190
Grand total—value of gross national product per capita	$852	$825	$855	$794	$612	$761

* Less than 50 cents.

the gross national product, of (a) capital items purchased from depreciation and depletion allowances, and (b) the cost of all governmental services rendered to persons and governmental expenditures for capital purposes without allowance for the "inflation" or duplication of values which may result from taxation processes.

THE METHOD OF EXPECTED NUMBERS FOR TABLES OF MULTIPLE CLASSIFICATION WITH DISPROPORTIONATE SUBCLASS NUMBERS

By George W. Snedecor, *Iowa State College*

This Journal has recently carried two articles [1] on disproportionate numbers in tables of double classification. The widespread occurrence of such tables prompts me to present still another method of solution, one having the advantages of ease of computation and a wide range of applicability.

The method of fitting constants, as presented by Yates and Brandt, while possessing great simplicity and orthodoxy of theory, is forbiddingly intricate of calculation if the table is at all extensive. On the other hand, Yates' two methods of weighted squares of means and unweighted subclass means are relatively easy to compute, but are somewhat limited in the conditions under which they may be used.

The method here presented may be considered an extension of Yates' "simple approximate" method of unweighted subclass means. In that method, if the main class numbers are decidedly unequal, much information is lost by the assumption of a single item in the subclass. A more natural procedure is to use expected numbers in the subclass. Expected numbers may be defined as the numbers which would occur in the subclasses of a column if the total of that column were subdivided in proportion to the numbers in the column of totals. A similar definition, based on the rows, leads to the same set of expected numbers. Since such numbers are proportional, the difficulties inherent in disproportionate subclass numbers disappear. Not only may tables of multiple classification be investigated with relative ease, but analysis of covariance may be employed. Discussion of the validity of the method will be reserved until an example has been given.

The data chosen for presentation in Table I, furnished by Perry,[2] summarize the losses in weight of eggs during six months of cold storage. The hens in the several pens were fed different rations. The object of the experiment was to discover factors affecting the loss of weight. The numbers of eggs in the subclasses are not proportional, so

[1] A. E. Brandt, "The Analysis of Variance in a 2 X s Table with Disproportionate Frequencies," this Journal, 1933, Vol. 28, p. 164.

F. Yates, "The Analysis of Multiple Classifications with Unequal Numbers in the Different Classes," this Journal, 1934, Vol. 29, p. 51.

[2] Flavel D. Perry, "The Effects of Feed and Storage on the Physical Characteristics of Eggs," a thesis submitted for the degree Doctor of Philosophy, Iowa State College, 1934.

TABLE I

NUMBER OF EGGS AND LOSS IN WEIGHT (GRAMS) DURING SIX MONTHS OF COLD STORAGE

Ration	Number, sum of losses and mean	Year							
		1931		1932		1933		Total	
		Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
29.....	Number.....	19	18.6461	61	60.7164	56	56.6375	136	136.0000
	Sum of losses.....	48.00	47.1056	130.25	129.6416	145.84	147.5010	324.09	324.2482
	Mean.....	2.5263		2.1352		2.6043		2.3830	2.3842
30.....	Number.....	24	23.5818	82	76.7884	66	71.6298	172	172.0000
	Sum of losses.....	51.40	50.5051	167.69	157.0323	163.86	177.8353	382.95	385.3727
	Mean.....	2.1417		2.0450		2.4827		2.2265	2.2405
31.....	Number.....	24	22.2108	72	72.3239	66	67.4653	162	162.0000
	Sum of losses.....	45.30	41.9229	146.60	147.2587	169.96	173.7366	361.86	362.9182
	Mean.....	1.8875		2.0361		2.5752		2.2337	2.2402
32.....	Number.....	17	20.9769	76	68.3059	60	63.7172	153	153.0000
	Sum of losses.....	42.70	52.6898	169.17	152.0421	161.06	171.0361	372.93	375.7680
	Mean.....	2.5118		2.2259		2.6843		2.4374	2.4560
33.....	Number.....	19	20.7026	64	67.4131	68	62.8843	151	151.0000
	Sum of losses.....	42.30	46.0902	120.07	126.4737	172.06	159.1161	334.43	331.6800
	Mean.....	2.2263		1.8761		2.5303		2.2148	2.1966
34.....	Number.....	15	18.9203	67	61.6092	56	57.4705	138	138.0000
	Sum of losses.....	38.50	48.5627	150.88	138.7378	136.67	140.2568	326.05	327.5573
	Mean.....	2.5667		2.2519		2.4405		2.3627	2.3736
35.....	Number.....	17	17.6864	55	57.5912	57	53.7224	129	129.0000
	Sum of losses.....	32.80	34.1241	130.29	136.4278	152.13	143.3797	315.22	313.9316
	Mean.....	1.9294		2.3689		2.6689		2.4436	2.4336
36.....	Number.....	25	17.2751	44	56.2519	57	52.4730	126	126.0000
	Sum of losses.....	65.80	45.4681	105.82	135.2858	148.09	136.3301	319.71	317.0840
	Mean.....	2.6320		2.4050		2.5981		2.5374	2.5165
Total...	Number.....	160	160.0000	521	521.0000	486	486.0000	1167	1167.0000
	Sum of losses.....	366.80	366.4685	1120.77	1122.8998	1249.67	1249.1917	2737.24	2738.5600
	Mean.....	2.2925	2.2904	2.1512	2.1553	2.5713	2.5704	2.3455	2.3467

that the ordinary methods of computing analysis of variance fails. Since the total numbers in the different years and in the different pens are far from equal, the only suitable method hitherto available is that of fitting constants.

In Table I the expected numbers for the year 1931 are calculated very simply by multiplying the ratio $160/1167=0.1371$ by 136, 172, 162, . . . 126 successively. For 1932 the ratio $521/1167$ is used. The expected numbers in each row and column must total the same as the actual numbers.

The expected sum of the losses in the first cell of the table is

$$(48/19)\ (18.6461)=47.1056,$$

the quotient, $48/19=2.5263$ grams, being the mean loss in weight for this group. The expected sums in the remaining subclasses are calculated in a similar manner. The expected sum for pen number 29 is, then,

$$47.1056+129.6416+147.5010=324.2482.$$

The computation of the analysis of variance is now carried through as usual,[1] the proportional expected numbers and expected sums being used instead of the actual. The sum of squares within pen-year subclasses is calculated from the original data. The results are shown in Table II. For comparison, the corresponding statistics calculated by

TABLE II

ANALYSIS OF VARIANCE OF LOSSES IN WEIGHT OF EGGS DURING SIX MONTHS OF STORAGE

Source of variation	Degrees of freedom	Mean square	
		Method of expected numbers	Method of fitting constants
Within sub-classes	1143	0.567	0.567
Between means of years	2	21.9	22.0
Between means of pens	7	1.97	1.95
Interaction	14	1.11	1.10

fitting constants are entered in the adjacent column. The differences in the results from the two methods are trivial.

Returning now to the question of the theoretical foundation of this proposed method, it should be noted first that the use of expected numbers is of common occurrence. Usually it is pertinent to ask if the actual numbers may be reasonably assumed to be the result of random sampling from populations in which the attribute investigated occurs with unequal but proportional numbers. The statistic, χ^2, is employed to test the validity of this assumption. Since the expected numbers are already entered in the table, the labor of computation of χ^2 is small. Its value for Table I is 11.74, with $P=0.63$, so there is no reason to believe that this sample may not have been derived from a population with proportional numbers.

The next point to be noted in connection with theory is that neither the subclass means nor the class numbers are disturbed during adjustment to expected values. The subclass means are known to be efficient estimates of the variable under investigation. The change from actual to expected numbers is merely a matter of weighting, usually of minor consequence unless carried to extremes. The χ^2 test may be invoked if the seriousness of the adjustment is in question.

A third feature of theory is that the population from which a sample is drawn is often assumed to have proportional subclass numbers, the

[1] George W. Snedecor, *Calculation and Interpretation of Analysis of Variance and Covariance* (Example 6). Collegiate Press, Inc., Ames, Iowa. 1934.

disproportion in the sample being attributable to sampling variation. Under such an assumption, the method of expected numbers is peculiarly appropriate.

The method of expected numbers has been tested rather extensively in our laboratory during the last year.[1] Samples with disproportionate numbers were drawn from a population of known composition. The samples were treated by the various available methods. Uniformly concordant results were obtained by the two methods of fitting constants and expected numbers. A notable feature of the sampling experiments was this: the variation in the results of the several methods of treatment was trivial compared to the deviations of the sampled statistics from the population parameters.

We have discovered only one case in which the method of expected numbers failed to give the results consistent with those from fitting constants. A portion of the data is reproduced in Table III.[2] The contrasts illustrated by districts 1 and 3 explain the failure of expected numbers to yield reliable results. In district 1 most of the farms are intermediate in size, whereas in district 3 most of them are small. The disproportionate subclass numbers are characteristic of the dis-

TABLE III

NUMBERS OF FARMS IN IOWA WHICH WERE TABULATED BY THE UNITED STATES CROP REPORTING BOARD, 1933

District	Number of acres planted in corn									
	0–29		30–59		60–89		90–149		150 up	
	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
1.....	7	39.9	68	76.3	71	55.1	55	34.0	16	11.7
2.....	32	43.9	86	84.0	68	60.7	44	37.4	9	12.9
3.....	100	43.9	97	84.0	31	60.7	9	37.4	2	12.9
4.....	18	51.8	71	99.2	98	71.7	67	44.1	28	15.2
5.....	35	55.3	104	105.8	92	76.5	48	47.1	22	16.3
6.....	57	47.6	115	91.1	48	65.8	32	40.6	7	14.0
7.....	24	41.9	73	80.2	58	57.9	49	35.7	24	12.3
8.....	73	41.9	81	80.1	43	57.9	22	35.7	9	12.3
9.....	59	38.8	80	74.2	51	53.6	19	33.0	2	11.4

tricts. The substitution of proportional numbers tends to obscure this feature of the data. The value of χ^2 is 348, leaving no doubt that expected numbers are inappropriate. The analyses of variance by the methods of expected numbers and fitting constants are set out in Table IV. According to the method of expected numbers the mean

[1] George W. Snedecor and Gertrude M. Cox, "Disproportionate Subclass Numbers in Tables of Multiple Classification," *Iowa Agricultural Experiment Station Research Bulletin*, 1934.

[2] The data were made available by L. M. Carl, Agricultural Statistician for Iowa, Division of Crop and Livestock Estimates, Bureau of Agricultural Economics, United States Department of Agriculture.

TABLE IV

ANALYSIS OF VARIANCE OF CORN YIELDS IN IOWA, 1933

Source of variation	Degrees of freedom	Mean square	
		Method of expected numbers	Method of fitting constants
Within sub-classes	2159	140	140
Between district mean	8	4406	4794
Between means of size groups	4	440	158
Interaction	32	269	165

square between means of groups is significantly great, a conclusion not verified by fitting constants.

On the basis of the evidence presented it is believed that the method of expected numbers, applied to tables of multiple classification with disproportionate subclass numbers can be relied upon to give satisfactory results unless the value of χ^2 is significantly great. Only in cases where critical questions are involved need the labor of fitting constants be undertaken. The proposed method is also available for tables of multiple classification, and for analysis of covariance.

AN EXPERIMENT IN ADVISORY SERVICE

THE COMMITTEE ON GOVERNMENT STATISTICS AND INFORMATION SERVICES

By Meredith B. Givens, *Executive Secretary*

During the past eighteen months the American Statistical Association and the Social Science Research Council have coöperated in sponsoring an experiment in the mobilization of statistical advisory services to the Federal Government. The agency established for the purpose is the joint Committee on Government Statistics and Information Services (COGSIS), which began work in June, 1933.

This experiment, though not unprecedented, represents one of the most significant activities in which the American Statistical Association has been involved. For nearly one hundred years the Association has maintained close and friendly relations with the major statistical agencies of the Government, and has frequently been called upon for advice. The work of COGSIS is a culmination of these activities. A special budget of one hundred thousand dollars has made possible a thorough test of the practicability of direct collaboration at close quarters.[1]

The swift expansion of governmental functions in the economic crisis has necessitated an immediate and thorough reappraisal of the statistical services needed in the implementation of the recovery program, in its urgent administrative aspects and in terms of its longer-range implications. Fresh and vigorous personnel have been added to the ranks of governmental statisticians and administrators, and the situation has been malleable to an unusual degree. Clearly, it has been the duty of organizations outside of Government to respond wholeheartedly to any call for assistance. The call first came in the form of an invitation from the Secretaries of Agriculture, Commerce, Labor, and the Interior, "to furnish immediate assistance and advice in the reorganization and improvement of the statistical and informational services of the Federal Government."

Improvement and closer integration of government statistics is indispensable to the rapid advancement of social research. Two decades of remarkable growth in the scope of statistics and of the facilities for their collection have witnessed an increasing unevenness in quality and coverage. The extension of our understanding of social

[1] For a period of eighteen months, terminating December 31, 1934, the work of the Committee has been financed by a grant from the Rockefeller Foundation to the Social Science Research Council.

problems depends heavily upon planned improvement of original reporting and of the analytical work conducted under the auspices of scattered and decentralized government agencies. COGSIS has endeavored to serve as promptly and effectively as possible in the emergencies of expansion and realignment, at the same time keeping in mind these longer-range needs of social research.

In various ways the Committee's program has been handicapped by its temporary character, by the necessity for quick assembly of personnel, and by a continued drainage of that personnel into operating responsibilities within the government. Regretful as the Committee has been for the loss of major staff at inopportune times, it is gratified that its presence has contributed new personnel in positions of continuing responsibility in the conduct of the services under review.

The present article, which sketches in brief outline the leading phases of the work of COGSIS,[1] embraces a brief description of the activities of the Advisory Committee to the Secretary of Labor, whose work has been integrated with and staffed by COGSIS.

Twelve members of the affiliated Committees have at various times been active members of the Washington staff, and each non-resident member has devoted the equivalent of two to four full-time weeks to the program. Of the total personnel of the combined Committees, totaling some 57 persons, more than 20 have assumed direct responsibilities in the services under review.[2]

As a result of the activities of the year, improvements have been achieved which have been sought for years by individuals and scientific groups. Many aspects of the Committee's work have been intimately

[1] For current reports of the Committee's work, including origin and organization, see this JOURNAL, September, 1933, pp. 333–4; December, 1933, p. 438; March, 1934, Supplement, pp. 207–8; June, 1934, pp. 194–6; September, 1934, pp. 319–20.

[2] The present membership of COGSIS is as follows: Frederick C. Mills, *Chairman*, Meredith B. Givens, *Executive Secretary*, Donald Belcher, Murray R. Benedict, William J. Carson, Robert E. Chaddock, Ewan Clague, J. Frederic Dewhurst, Bryce M. Stewart, Samuel A. Stouffer, and Ralph J. Watkins. Past members were: John D. Black, Morris A. Copeland, W. Leonard Crum, Edmund E. Day, Stuart A. Rice, and Willard L. Thorp. Up to January 1, 1934, Dr. Day served as Chairman.

The Advisory Committee to the Secretary of Labor was appointed by the American Statistical Association in March, 1933, "to confer and advise regarding the method, adequacy, usefulness, and general program of the Bureau of Labor Statistics," and to carry through a comprehensive survey of the statistical work of the Department of Labor. The membership of the Advisory Committee is as follows: Bryce M. Stewart, *Chairman*, Ewan Clague, *Secretary*, Murray W. Latimer, Morris A. Copeland, J. Frederic Dewhurst, Meredith B. Givens, Ralph G. Hurlin, Aryness I. Joy, and Howard B. Myers. Past members were: Stuart A. Rice and Sidney W. Wilcox.

In addition to Committee members the following have served with the COGSIS staff for varying periods: Henry B. Arthur, Viva Boothe, Hazel F. Briggs, Edward H. Chamberlin, Florence M. Clark, John H. Cover, Calvert L. Dedrick, Ralph C. Epstein, Edwin M. Fitch, C. Luther Fry, Wilbur I. Gooch, Edward R. Gray, E. D. Hackett, Mildred L. Hartsough, Adelaide Hasse, William M. Hoad, Margaret H. Hogg, Joseph B. Hubbard, Ralph G. Hurlin, Margaret Klem, Solomon Kuznets, Edna Lonigan, George Miale, A. Howard Myers, Jacob Perlman, Morris Ploscowe, Lowell J. Reed, C. S. Slocombe, Constant Southworth, T. Squire, George W. Stocking, Woodlief Thomas, Tracy E. Thompson, Ernestine Wilke, Helen R. Wright.

related to the internal operations of government agencies, and no formal report can deal adequately with them. Piecemeal as the operating activities have been, an underlying plan and point of view have governed the general program. It is to be hoped that the purposes of the enterprise will be further consolidated and extended by the Committee's final report, by the continuing work of the Central Statistical Board within the government, and by further activity on the part of the two scientific organizations which have sponsored the venture.

The firm establishment of a central planning and coördinating statistical agency within the Federal Government has been a leading objective in the Committee's program. In its *Blue Memorandum*, "The Statistical Services of the Federal Government in Relation to the Recovery Program" (July 5, 1933), the Committee suggested that the recovery program be made the occasion for reorganization and coördination of the services, and to this end the establishment of a central statistical board was proposed. In line with this proposal, the present Central Statistical Board (CSB) was established by President Roosevelt (Executive Order No. 6225, July 27, 1933).

The structure and early activities of CSB are described in its published *Interim Report* (February, 1934), which reflects certain early, closely related activities of COGSIS. As specified in the Executive Order the Board's membership includes a representative of COGSIS, and the Executive Secretary of the Committee has served as a full member of the Board from its inception to the present time. A member of the Committee's major staff was loaned to the Board as Executive Secretary in August, 1933, and in September, 1934, was officially appointed to this position. At the beginning the combined staff for the Committee and the Board was provided by COGSIS, but the work of the two organizations has gradually been differentiated during the winter and spring.

The Board's activities have ranged widely over the broad field of Government statistics, but its authority is based explicitly upon powers granted to the President by the NIRA, which extends only to June 16, 1935. COGSIS has therefore concerned itself with proposed legislation for the permanent establishment of the Board. Meanwhile the Board's powers are made more specific in a second Executive Order (No. 6700, May 4, 1934).

In addition to its general collaboration with the Board the Committee recently has emphasized fields which fall in the borderland of the Board's present activities.

The Committee's *Blue Memorandum* of July, 1933, proposed the

establishment of a central statistical service agency. The purpose of this proposal has been effectuated in part by the activities of the Division of Special Tabulations of the Bureau of the Census in serving various projects initiated by the Civil Works Administration and other agencies. The mechanical equipment of the Department of Commerce is now concentrated in the Bureau of the Census, and the divisions of that Bureau tabulate for the entire Department.

In June, 1933, the Committee's attention was immediately drawn to an emergency which then confronted the statistical services. Irreparable damage to certain important services was threatened by drastic budget cuts under the economy program. Specifically, the maintenance of statistics of foreign trade, and of important current reports on industry gathered by the Bureau of the Census and by the Bureau of Mines, was endangered. COGSIS proposed that NRA funds should be transferred to the agencies involved to assure the continuance of these essential services without curtailment and with established personnel. This end was accomplished for the period ending December 31, 1933. CSB now has undertaken the further protection of these services, and further allotments have been made by the Director of the Budget.

In January, 1934, the Director of the Census asked CSB to undertake a survey of the work of the Bureau of the Census in the fields of manufactures, agriculture, and population. COGSIS has coöperated with the Board in each of these studies, giving special emphasis to the survey of the Census of Manufactures, which absorbed the full time of one of the Committee's major staff members for a period of five months. Under the auspices of the special committee which has supervised the inquiries, an examination of personnel and organization of the Division of Manufactures was completed by members of the Civil Service Commission staff.

Several suggestions growing out of the survey of the Census of Manufactures have already been adopted. Other recommendations are now under consideration. Among the broad subjects dealt with in the survey were the possible relaxation of restrictions placed upon the census data by the disclosure rule, checks on adequacy of coverage in reporting, coöperation with the specialized agencies of both Federal and state governments, the segregation of statistics for industrial areas, the possibilities of an annual Census of Manufactures, the appropriateness of the collection of current statistics as a part of the census program, and the proper sphere of activity of the Bureau in relation to other statistical agencies. Arrangements have been made for machine tabulation of the 1933 Census of Manufactures.

The study of the Census of Population has stressed broad problems of administration and policy rather than detailed criticism of specific phases of the decennial census. These problems include, among others: (1) the practicability of providing a larger permanent staff of experts during intercensal periods; (2) the need for more analysis, including studies of the accuracy of enumerations; (3) the feasibility of wider use of sampling technique; (4) the importance of keeping step with social changes, for example in internal mobility, occupations, and family structure and size.

Extensive memoranda have dealt with the Census of Agriculture. Special study has been given to the general function of that Census, its relation to the Division of Crop and Livestock Estimates, the preparation of schedules, problems of field canvass, the selection and training of supervisors and enumerators, organization within the Division, particularly the adequate provision for technical specialists, and problems of editing and tabulation. Members of the Committee's staff have aided in the construction of the schedules for the current Census of Agriculture.

Conclusions based upon the census inquiries have stressed the need for a well-developed research section in the Bureau of the Census, with a staff of technically trained economists, demographers, and statisticians.

A series of memoranda has been prepared on various phases of agricultural statistics. CSB and COGSIS were instrumental in avoiding the threatened elimination of the Division of Agricultural Finance in the Bureau of Agricultural Economics. The Committee's expert in agriculture has collaborated with a special committee of CSB to which the Farm Credit Administration and the Bureau of Agricultural Economics have submitted their plans for further work in agricultural finance, with a view to greater coördination of work and to the extension of long-range analytical research. In connection with the curtailment of the Market News Service, the Committee suggested modifications consistent with the preservation of the essential features of the service, which has since been largely readjusted to a normal basis.

Other memoranda have dealt with the changing objectives to be served by agricultural statistics, particularly in view of the work of the Agricultural Adjustment Administration; the need for more adequate price data; the problem of estimating the incomes of farm people; statistics of the movement of agricultural products; data concerning forestry and forest products; and special problems of interagency relationship. Various other problems in this field have been suggested for further study by CSB.

The extension and coördination of reporting under the recovery program has received a major portion of the Committee's attention, especially during the early months. The affiliated committees and the Board have repeatedly urged the importance of maintaining the integrity of the basic reporting services of the permanent agencies, and of fully utilizing the work of these agencies under the recovery program. The planned extension of the government's participation in trade reporting has likewise been urged. Under NRA Office Order 34 (September 12, 1933) and Executive Order No. 6479 (December 7, 1933) it is now provided that in addition to information required by the code authorities, the Administrator may require additional statistical information to be furnished to government agencies. A further Administrative Order (No. x10, March 16, 1934) designated the Bureau of Labor Statistics as the official agency for the collection of labor statistics required by the NRA. To effectuate this policy the Board has detailed a full-time staff member and a special committee to assist in the development of appropriate procedures pursuant to the order.

Recommendations have been made, upon request, relating to duplication of work between the Bureau of Mines, the United States Geological Survey, and the Bureau of the Census, and dealing with other similar matters.

In August, 1933, a preliminary canvass of existing governmental services dealing with construction statistics and a critique of these services was undertaken. A report on September 7 was followed by the creation of a continuing committee of CSB to explore this problem further. The recommendations of both organizations are concerned with the creation of a central analytical unit in this field, and with the allocation of statistics of construction among the various Federal agencies. A census of structures was proposed at a conference on physical-commodity statistics in May, 1933.[1] This proposal was later considered by COGSIS and by the Director of the Bureau of Foreign and Domestic Commerce. The inauguration of two CWA projects, the Real Property Inventory and the Financial Survey of Urban Housing, is in harmony with the developments recapitulated above. Further planning in this field is under consideration by CSB; its importance is emphasized and increased by the appearance of the Federal housing program.

The work of the Bureau of Foreign and Domestic Commerce and its relation to that of the Bureau of the Census has been the subject of a detailed report. In response to a request from the Assistant Secretary

[1] See "Report of the Conference on Physical Commodity Statistics" (mimeographed), 1933, Social Science Research Council, New York.

of Commerce, the Committee completed a survey of the statistical work of the Bureau of Fisheries.

On March 20, 1934, an Interim Report from the Advisory Committee to the Secretary of Labor was submitted to Secretary Perkins, summarizing the progress of work at that time. In acknowledging the report, the Secretary expressed her "sincere appreciation of the painstaking and excellent analyses that have been submitted both to me and to the Commissioner of Labor Statistics. . . . The work of the Committee has been exceedingly helpful, not only in improving the work being done by the Bureau of Labor Statistics but also in increasing the effectiveness of the Bureau's reports."

Phases of labor statistics proper to which the Advisory Committee has given special attention include the following:

1. *Employment and payrolls.*—A number of memoranda have been submitted, and the Committee's recommendations have been adopted practically in their entirety.[1]

2. *Wages, hours, and working conditions.*—On January 16, 1934 the Committee suggested that the Bureau of Labor Statistics adopt a flexible policy with a view to meeting the urgent needs, under changing conditions, of certain industries for this type of data. The recommendations regarding schedules, tabulating, analysis, publication, etc., have been adopted in so far as practicable in an experimental study of the petroleum industry now under way in coöperation with the Labor Policy Board of the Petroleum Administrative Board. This study, proposed by the Advisory Committee, marks a new departure in that a code authority is for the first time availing itself of the Bureau's expert services. A member of COGSIS staff has been engaged to supervise this study. As urged by the Advisory Committee, the experimental studies of job specifications conducted by the United States Employment Service are now being coördinated in part with the Bureau's wages and hours surveys. It is felt, further, that these surveys can be planned in closer relation to the payroll and employment reports.

3. *Industrial disputes.*—On January 16 recommendations for the improvement of the statistics of industrial disputes were submitted.

4. *Accident statistics.*—A report has been presented to the Secretary of Labor pointing out the inadequacy of current statistics of industrial accidents, emphasizing the importance of Federal stimulus for the improvement of state reporting services, and of standardization in classification and terminology, and stressing adequate statistical reporting as a basis for accident prevention. The desirability of consolidation,

[1] Progress in this field is summarised in detail in a paper by Aryness Joy, "Recent Progress in Employment Statistics," pp. 355–371 of this number of the JOURNAL.

analysis, and interpretation of basic reports from state and other agencies is pointed out.

5. *Coördination between the Women's Bureau and the Bureau of Labor Statistics.*—At the request of the Secretary, a memorandum calling attention to the existing duplication of work between these two agencies, together with suggestions for achieving coördination, was submitted on April 2.

6. *Personnel.*—The attainment of satisfactory standards of technical proficiency by the Bureau of Labor Statistics is contingent upon the improvement of its personnel. Staff memoranda have dealt with the need for higher civil-service classifications for technical positions. On June 22 examinations were given for newly created positions in seven fields of labor statistics, and it is expected that new appointees will materially strengthen the personnel of the Bureau.

7. *Miscellaneous.*—The Advisory Committee has given attention to various other phases of labor statistics, such as labor turnover, productivity, the measurement of unemployment, and statistics of organized labor. Questions of internal organization have also been considered.

COGSIS was instrumental in establishing CSB's Interdepartmental Committee on Retail Price Reporting, and in developing plans for the extensive Civil Works Administration project supervised by this committee under the direction of a member of COGSIS staff. The results of the project will be utilized to improve the Federal retail-price reporting system.

In conformity with suggestions embodied in a series of memoranda, the Bureau of Labor Statistics has been engaged in revising its wholesale-price work. With aid and advice from the Committee's staff, the technical problem of computing the index has been examined, and the method of weighting is to be improved. Tests have been made of the extent and adequacy of the reporting sample.

Rapid progress in the complex field of family expenditures and cost of living has not been possible. A major part of the Committee's current work has been concerned with plans for the improvement of the BLS index of the cost of living, and the Committee's suggestions for the inauguration of immediate improvements in this index have been adopted. At the Committee's suggestion, coöperative arrangements were made between the Bureau of Labor Statistics and the Bureau of Home Economics whereby an experimental study of the cost of living of government employees was directed by a member of the major staff of the latter organization, who has since been transferred to direct the continuing work of the Bureau of Labor Statistics in this field. The Committee has coöperated in planning the current field study of family

expenditures, and has stressed the desirability of extending this inquiry through collaboration with other agencies, and of coördinating it both with the current work on the cost-of-living index and with more comprehensive plans for the study of family living. Periodic cross-section studies of expenditures should be related to the current indexes in a systematic manner, and the expenditure studies should serve the broad purposes of all users of the data. An adequate plan for work in this neglected field will call for the collaboration of various Federal Departments and agencies.

Preliminary investigations of the Committee indicate the need for a comprehensive general program for the collection, compilation, and analysis of statistics of relief and welfare, to be coördinated by a permanent Federal relief agency if such an agency is established. For the immediate future, plans should look to the centralization of statistics of public relief in the statistical division of the Federal Emergency Relief Administration, while the Children's Bureau should foster and strengthen its statistics of private relief until such time as their transfer to another agency may seem desirable.

A report relating to the work of the Children's Bureau has been submitted, recommending that that agency should concentrate its energies upon the collection of statistics of all aspects of child welfare. Careful planning and coördination are required to prevent unnecessary overlapping between the work of the Children's Bureau and of such other agencies as the Women's Bureau and the Federal Emergency Relief Administration.

A comprehensive report deals with Federal collection of criminal statistics, covering offenses against both Federal and state laws. Recommendations are made concerning a standard classification, techniques of collection, and a central statistical bureau to coördinate this work. A conference on criminal statistics was held under COGSIS auspices in Washington on June 11. A plan for the establishment of a central statistical bureau in the Department of Justice is now receiving favorable consideration.

A mail inquiry has indicated certain issues in connection with statistics of immigration and emigration on which the opinions of expert users of these statistics would be helpful. A digest of these opinions has been prepared and recommendations have been made.

With coöperation from members of the staff of Teachers College, Columbia University, a survey of education statistics has been drafted for review. The Committee sponsored a conference of experts held June 4 in the Office of Education to consider the feasibility of carrying out certain changes. The survey envisages a broad program and

blocks out problems for further detailed investigation by the Office of Education and other agencies in the long-term development of needed reporting services in this field.

The Committee staff has completed an investigation of the problems involved in the frequently proposed transfer of the Division of Vital Statistics from the Census to the Public Health Service. Final recommendations have not yet been made. Members of staff have aided in two actions which seemed most needed in improving the current reporting of births and deaths, namely: (1) development of a program, now under way, using Census and Federal Emergency Relief funds to promote greater accuracy of birth registration in about twenty states needing it most; and (2) arrangement for nation-wide allocation of births and deaths to place of residence, which is to be instituted as of January 1, 1935. Other problems, such as maintenance of closer relations with state registrars, improvement of classification of causes of death, and the speeding up of publication, have been studied. The epidemiological statistics of the Public Health Service have also been reviewed.

An inquiry is nearing completion on the practicability of the early reëstablishment by the Bureau of the Census of its reports on marriage and divorce statistics, with modifications of the past procedure in the direction of greater utility, accuracy, and economy.

The Committee has felt that the consumer services of the government should be developed and expanded under the leadership of a single agency. A draft memorandum on these services embodies specific recommendations for coördination by such an agency. Wider publicity should be given, probably through a periodic publication, to the findings of such agencies as the Food and Drug Administration and the American Medical Association, particularly as they relate to labeling and advertising. The establishment of standards should be expedited. A list of government publications of interest to the consumer, proposed by a member of the Committee staff, has recently been published by the Government Printing Office. A special memorandum on consumer credit proposes various innovations, such as (1) annual reporting by installment-finance companies; (2) the expansion and reorganization of the semiannual retail-credit surveys of the Bureau of Foreign and Domestic Commerce; (3) the organization of annual national compilations for personal-finance companies and for industrial banks; (4) expanded reporting by building and loan associations; (5) annual reporting by pawnbrokers; (6) annual reporting by personal-loan departments of commercial banks; (7) improved reporting by credit unions; and (8) official publication of annual data on remedial-loan associations.

Interdepartmental conferences on a general-purpose industrial classification were held on May 2 and June 12, attended by representatives of the Bureau of Internal Revenue, Bureau of Labor Statistics, Census, Tariff Commission, National Recovery Administration, CSB, U. S. Employment Service, and COGSIS. A memorandum of June 16 proposed a plan for a standard classification, together with specific recommendations for its establishment. These suggestions are directed particularly to the Bureaus of the Census, Internal Revenue, and Labor Statistics, and pertain only to manufacturing industries; it is hoped that CSB may later give attention to this difficult problem in these and other fields.

Only limited study of treasury statistics has been possible. Recently, the attention of interested agencies has been directed to the fact that the provisions of the Revenue Act of 1934 threaten to impair the comparability of returns filed by corporations reporting on a fiscal year prior to and subsequent to December 31, 1934. CSB has been urged to consult with the Treasury regarding ways, means, and facilities for providing the necessary breakdowns and groupings to preserve the needed comparability of data.

The Committee planned and aided in the initial conduct of three statistical projects conducted under appropriations by the Civil Works Administration. The purpose of the Employment and Payrolls project was to enable the Bureau of Labor Statistics to expand its reporting services to include a more adequate sample in various nonmanufacturing fields, such as wholesale and retail trade, building construction, and the like, as well as service agencies, such as hotels. A Trial Census of Unemployment was conducted to experiment with schedules, instructions, and procedures to arrive at best devices for taking unemployment censuses and to test the practicability of a sampling method. The Retail Price Reporting project, already referred to, was planned by a member of COGSIS staff, who later became its field director.

Throughout its work the Committee has stressed the importance of horizontal studies, such as those of the national income, which require unification of pattern and method in the underlying services.

The Committee's general report will synthesize and supplement the direct operating activities of the year, and will undertake an integrated treatment of the services, their relation to administration, to scientific advance, and to governmental policy and planning. The report will contain discussion of the tasks of coördination and planning, as exemplified by the experience of other countries, by the background of effort in the United States, and by the experience and prospects of present organization in this country. The field for unofficial advisory services will also be considered in the light of the experience of the affiliated committees.

NOTES

SUMMATION METHOD OF FITTING PARABOLIC CURVES AND CALCULATING LINEAR AND CURVILINEAR CORRELATION COEFFICIENTS ON A SCATTER-DIAGRAM

By Chen-nan Li, *Standard Statistics Company*

The summation method has been used in curve-fitting and correlation by several statisticians, notably Elderton [1] and Warren and Mendenhall.[2] Elderton gave an example of this method in the calculation of moments and Warren and Mendenhall adapted it to the calculation of the Pearsonian correlation coefficient by means of the Hollerith tabulating machines.

It is strange, however, that such a beautiful method has not been made known to a larger number of statisticians and that those who are familiar with it do not seem to know the many uses to which it may be put. So far as the writer is aware, no one has adapted it to fitting curves and calculating the correlation coefficient or the index of correlation on a scatter-diagram. Stranger still, no one has published any method by which the weights to be applied to the cumulative totals of the summation process to derive the sums of the powers and cross products of the variables may be mathematically determined. In this article the writer presents a method he has developed for the simultaneous determination of such weights and a method of adapting the summation technique to curve-fitting and correlation when data are plotted on a scatter-diagram.

To show in the simplest way the logic of the summation method, the following illustration is given:

x	y	y_1	y_2	y_3	y_4	y_5
4	a	a	a	a	a	a
3	b	$a+b$	$2a+b$	$3a+b$	$4a+b$	$5a+b$
2	c	$a+b+c$	$3a+2b+c$	$6a+3b+c$	$10a+4b+c$	$15a+5b+c$
1	d	$a+b+c+d$	$4a+3b+2c+d$	$10a+6b+3c+d$	$20a+10b+4c+d$	$35a+15b+5c+d$

In this example x is represented by consecutive numbers from one to four and y by letters from a to d. Columns under y_1, y_2, y_3, y_4, and y_5

[1] Elderton, W. P., *Frequency Curves and Correlation*, Chapter III, Charles & Edwin Layton, London.
[2] Warren, R. and Mendenhall, R. M., *The Mendenhall-Warren-Hollerith Correlation Method*, Columbia University Statistical Bureau, Document No. 1.

show the subtotals of y cumulated once, twice, three, four and five times respectively.

Now it is apparent that the last item of column y_1 is the sum of y or Σy. It can also be readily seen that in the last item of column y_2 a is added four times, b three times, c twice and d once. If we should multiply each y by its corresponding x and sum up the products, we would have obtained $4a+3b+2c+d$, the same value as the last item in column y_2.

From columns y_2, y_3, y_4, and y_5 we can obtain the sum of the products of y with any power of x up to and including Σx^4y by applying proper weights to the last items of the columns concerned. For example, let it be required to find the value of Σx^2y. Here all that is necessary is to secure the weights to be applied to the last items of columns y_2 and y_3 so that the sum of the two items will contain $16a(4^2a)$, $9b(3^2b)$, $4c(2^2c)$ and $d(1^2d)$. Let the weights be w_2 and w_3 respectively and write the following four equations:

$$\begin{aligned}
&1.\ 4w_2+10w_3=16\\
&2.\ 3w_2+\ 6w_3=\ 9\\
&3.\ 2w_2+\ 3w_3=\ 4\\
&4.\ \ w_2+\ \ w_3=\ 1
\end{aligned}$$

Solving any two of the above equations, we find $w_3=+2$ and $w_2=-1$. Multiplying the last item in column y_3 by $+2$ and the last item in column y_2 by -1 and summing up the products, we have:

$$2(10a+6b+3c+d)\ -\ (4a+3b+2c+d)=16a+9b+4c+d=\Sigma x^2y$$

Σx^3y may be obtained in the same way except that here we have to include the last item of column y_4 and to use the cubes instead of squares of x on the right hand side of the following four simultaneous equations:

$$\begin{aligned}
&1.\ 4w_2+10w_3+20w_4=64\\
&2.\ 3w_2+\ 6w_3+10w_4=27\\
&3.\ 2w_2+\ 3w_3+\ 4w_4=\ 8\\
&4.\ \ w_2+\ \ w_3+\ \ w_4=\ 1
\end{aligned}$$

Solving any three of the above equations, we find: $w_4=+6$, $w_3=-6$, $w_2=+1$. Multiplying the last items of columns y_4, y_3, and y_2 by $+6$, -6 and $+1$ respectively, we have:

$$\begin{aligned}
&6(20a+10b+4c+d)\ -\ 6(10a+6b+3c+d)+4a+3b+2c+d=\\
&64a+27b+8c+d=\Sigma x^3y
\end{aligned}$$

To obtain Σx^4y, the same procedure should be followed. The only difference would be the inclusion of the last item of column y_5 and the use of the 4th powers of x as the numerical values in the equations.

The adaptation of the summation method to fitting curves of the potential series and calculating r and the index of correlation is illustrated in the accompanying scatter-diagram.[1] In this diagram the Y-scale is expressed in units of class-intervals of 5 points each and the X-scale in class-intervals of 4 points each. Figures on both scales represent lower limits of class-intervals. Thus, 25 on the Y-scale means from 25 up to but not including 30 and 84 on the X-scale means from 84 up to but not including 88. The Y-deviations are taken from 22.5, the mid-point of the class-interval from 20 to 24.99 · · ·, and expressed in terms of class-intervals from this arbitrary origin. The X-deviations are taken from 82, the mid-point of the class-interval from 80 to 83.99 · · ·, and expressed in class-intervals from this arbitrary origin.

Column fy to the right of the diagram gives the frequencies in each class-interval on the Y-scale and columns fy_1, fy_2, fy_3, fy_4 and fy_5 give the subtotals of fy cumulated, 1, 2, 3, 4, and 5 times respectively. Column fdx shows the X-deviations multiplied by the frequencies in each class-interval on the Y-scale and columns fdx_1, fdx_2, and fdx_3 show the subtotals resulting from cumulating fdx once, twice and three times respectively. The figures in the rows at the bottom of the diagram are obtained in the same way as those in the columns just described. The only difference consists in exchanging fx for fy and fdy for fdx.

The subtotals of the various summations are entered in the diagram merely for demonstration purposes. In actual work there is no need for transcribing these totals. The operator can perform all the summations on an adding machine and copy only the last items of the cumulative totals, which, as it will be seen, are values needed in the computations given in the lower right-hand corner of the diagram.

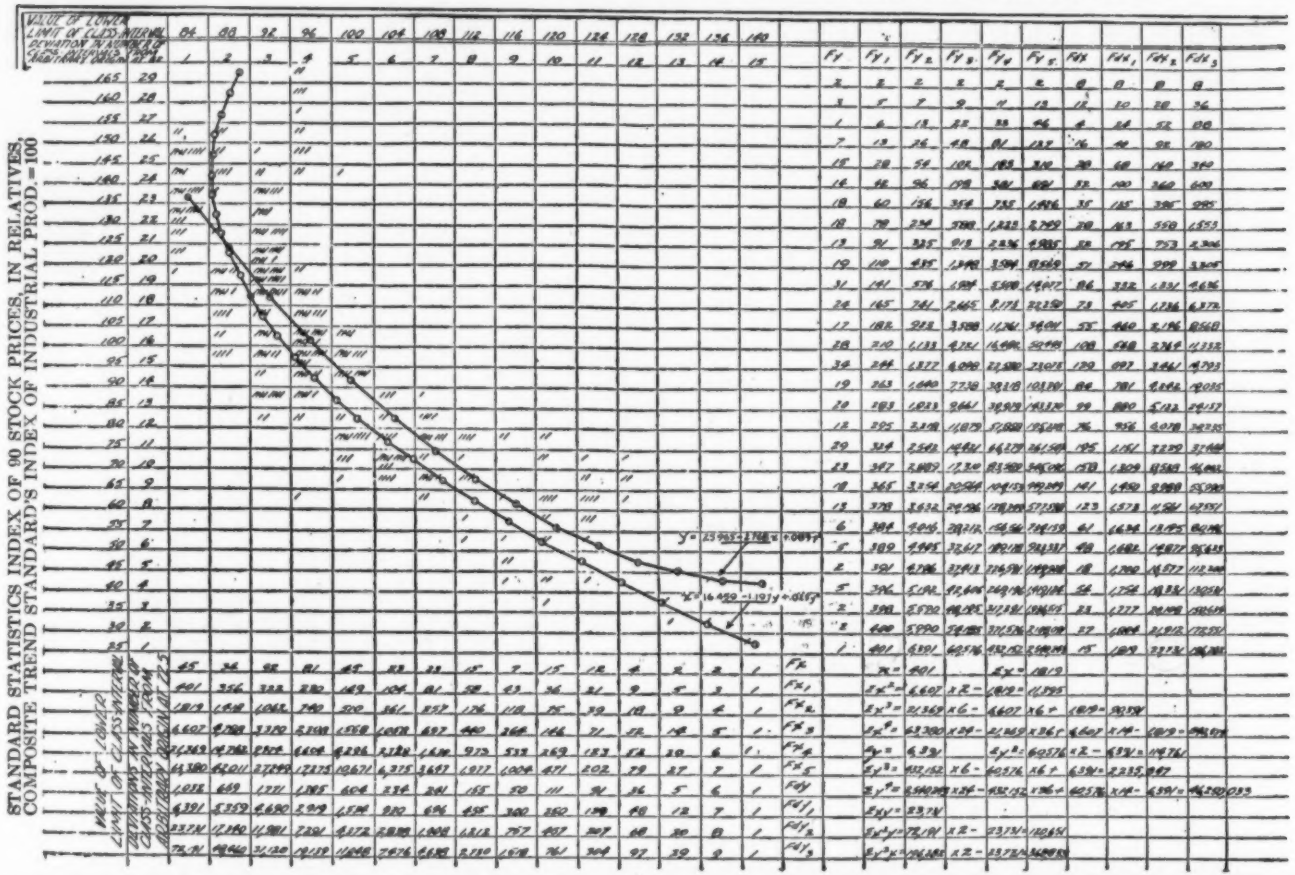
From the lower right-hand corner of the diagram we have all the necessary values to compute a straight line, two second degree parabolas, a linear correlation coefficient and two curvilinear correlation coefficients or indexes of correlation. Formulas for computing such curves and coefficients are given in several books on statistical methods and need not be reproduced here.

Attention should be called, however, to the fact that the curves computed by the method described in the foregoing paragraphs are expressed in terms of deviations from the arbitrary origins. They should be converted into actual units by the following formulas:

Straight Line $$\frac{Y-Y_o}{Y_i}=a+b\left(\frac{X-X_o}{X_i}\right)$$

[1] The writer is indebted to Mr. Alexander C. Muir of the Standard Statistics Company who drew the scatter-diagram and made the computations.

STANDARD STATISTICS INDEX OF YIELDS OF 60 BONDS, IN RELATIVES, AVERAGE 1900–1933 = 100


STANDARD STATISTICS INDEX OF 90 STOCK PRICES, IN RELATIVES, COMPOSITE TREND STANDARD'S INDEX OF INDUSTRIAL PROD. = 100
VALUE OF LOWER LIMIT OF CLASS INTERVAL
DEVIATION IN NUMBER OF CLASS INTERVALS FROM ARBITRARY ORIGIN AT 125
y = 25.955 - 3.768x + .0897x²
x = 16.429 - 1.191y + .0457y²

Second degree parabola with Y as the dependent variable

$$\frac{Y-Y_o}{Y_i}=a+b\left(\frac{X-X_o}{X_i}\right)+c\left(\frac{X-X_o}{X_i}\right)^2$$

Second degree parabola with X as the dependent variable

$$\frac{X-X_o}{X_i}=a+b\left(\frac{Y-Y_o}{Y_i}\right)+c\left(\frac{Y-Y_o}{Y_i}\right)^2$$

Here Y_o represents the arbitrary origin on the Y-axis and X_o the arbitrary origin on the X-axis. Y_i is the number of points included in each class-interval on the Y-scale and X_i the number of points included in each class-interval on the X-scale.

In the example given the parabolas are computed in terms of deviations and are plotted in the diagram against the deviations instead of actual numbers on the scales.

The advantages of the summation method described in this article over the conventional method of computing regression curves and coefficients of correlation are apparent. Instead of making individual multiplications to secure the cross products of variables, the same results are obtained by a simple process of cumulative addition. The labor required to total two columns of figures is insignificant compared with the labor required to multiply each figure in one column by a corresponding figure in another column and sum up the products. Moreover, with the summation method, there is no need for copying the results of various operations, because they are printed on the tape of the adding machine. This not only saves the time usually spent in writing but eliminates the possibility of incurring errors from copying figures. Accuracy of operations can easily be checked, because the sum of the subtotals of each summation must be equal to the last item of the next higher summation. If two parabolic curves are desired, several automatic checks are provided, for the last item of column fy_2 must be the same as the last item of row fdy_1, the last item of row fx_2 must be the same as the last item of column fdx_1 and the last items of column fdx_2 and row fdy_2 must be equal.

SAMPLING IN THE FIELD OF RURAL RELIEF

By A. Raymond Mangus, *Federal Emergency Relief Administration*

Much of the information which the research section of the Division of Research, Statistics and Finance in the Federal Emergency Relief Administration is called upon to supply is necessarily collected on a sampling basis. The present report aims to describe a procedure which has been adopted for selecting representative units for use in studying the rural relief situation.

A considerable fund of information is essential to the successful administration of the program of rural relief and rehabilitation. The first step in the sampling method was the compilation of a basic list of the more specific facts required. This list, based on the consensus of the rural research staff of the Federal Emergency Relief Administration, follows:

1. The number of rural families and rural persons on the relief rolls at a specified time.
2. The reasons why these families and persons are in need.
3. The place of residence of rural relief households, whether on farm or non-farm, and the occupation of rural relief persons, whether in agriculture or non-agriculture.
4. The race and nativity of rural relief cases.
5. The occupational status—whether owners, tenants, laborers.
6. The size of relief household.
7. The number of gainful workers per relief household.
8. The age composition of the relief household.
9. The prospects for rehabilitating the relief household.

Before a sample could be chosen for the study of these various aspects of rural relief, it was necessary to define the unit to be used as a basis of sampling, and the universe to be sampled. Since *a priori* information concerning various factors related to the above list of relief items was available by counties, the county was taken as the sampling unit.[1] This consisted of an aggregation of persons or families residing in a contiguous geographical area—the county. Not all families in the county would, however, come within the scope of a study of rural relief, hence the unit was narrowed to those aggregations

[1] The reliability of samples selected by any suitable method could be greatly increased if the size of the sampling unit were reduced, thereby increasing the number of units in the universe and in the sample which would be of practical use. However, since suitable data are not available by minor divisions within the county, and since the county is the unit of relief administration, it has not seemed practical to attempt to reduce the size of the county-unit.

of persons or families within the county residing outside of urban centers of 2,500 or over. No county that had any considerable number of rural families within its boundaries was excluded.

The unit of sampling was, then, the total population of families or persons residing in the villages and on the farms of the county. The assumption was that those counties which represent all families in certain aspects will at the same time represent the relief families in the same or related aspects. The aspects which were dealt with were the number or proportion of families or persons which fell within certain defined categories such as owners, tenants, laborers, villagers, etc.

Having defined the unit of sampling as the county or the rural part of the county, the question arose as to homogeneity and comparability of these units. It seemed clear that if all counties in the country were taken together as a universe, the heterogeneity of the aspects would, for sampling purposes, be so great as to result in a fruitless statistical compilation. Hence, the procedure was to so classify the units that the sampling process could be applied to a fairly homogeneous population of counties.

A priori information derived from the latest United States Census enabled us to mark out certain wide geographically contiguous areas, or belts, within which the units are similar enough to allow the choice of useful samples. The first area delimited was the Cotton Belt of the South.[1] The chief criterion for defining this area was the percentage of the total farm acreage in farms classified by type as cotton farms in the 1930 Census of Agriculture. The question as to the selection of an exact percentage of the farm acreage which should be given over to cotton production in order to constitute a cotton county, was settled by arbitrarily taking 40 per cent as the lowest limit. This simple method proved to be quite satisfactory in that it differentiated counties (575 in number) which fell together in a fairly continuous geographical area with rather clearly marked boundaries within which very few non-cotton, and outside of which very few cotton counties were found.

The criterion of farm acreage in cotton farms differentiated an area that was fairly homogeneous from the point of view of the dominant agricultural enterprise. In order to test the homogeneity of the units in other respects, the counties within the area were arrayed, by states, on the basis of a number of socio-economic criteria. These included such factors as race, per capita land value, farm tenancy, farm labor, and residence. On the basis of these, and other characteristics, includ-

[1] This report aims to describe a sampling procedure as it has been applied to the Cotton Belt. The same type of procedure has been used in sampling other areas of the country, viz., the Corn Belt, the Hay and Dairy Region, the Self-sufficing Farm Area, the Wheat-growing Regions, and the Lake States Cut-over Region. Still other areas are being defined.

ing the annual average rainfall and recent drought, the total Cotton Belt was separated into two divisions, the Eastern Cotton Belt with 426 counties, and the Western Cotton Belt in Texas and Oklahoma, with 149 counties. These areas were considered units, therefore, not only with respect to agricultural enterprise but also with respect to a complex of socio-economic factors.

The sampling technique used was based on the consideration that, if one set of facts is related to a second set of facts, a sample representative of the one set will at the same time be representative of the other. In this instance we had one set of unknowns, namely, relief factors as previously indicated. The problem was to select units with respect to known factors which, on *a priori* grounds, might be taken as related to the unknown relief factors about which information is required. There were, then, two sets of related factors to be kept in mind in the sampling technique employed. The known factors may be spoken of as independent variables, and the unknown, as dependent variables. Two considerations governed the selection of the independent variables used. The first was their assumed correlation with pertinent relief factors, the second, their relative permanency and stability in time and space.

The independent and dependent variables, between which significant relationships were assumed, are shown in the following comparative list:

Dependent Variables	*Independent Variables*
Residence of relief case	Per cent of all families in the county that are rural families
Residence and occupation of relief persons	Per cent of all rural families that are farm families
Occupational status of relief persons	Per cent of all farm operators that are tenants
Number of persons or cases on relief	Per cent of all gainful workers in agriculture that are wage laborers
Reasons why cases are on relief	Land value per capita of the rural farm population
Race of relief cases	Per cent of all rural families that are Negro families

No attempt was made to sample for such factors as size of families, gainful workers per family, age composition of families, the cost of relief, or prospects for rehabilitation. The first three of these vary, from county to county, within such narrow limits that they may be taken as fairly constant. Variation in the cost of relief is so largely a matter of administrative policy and practice that any effort at control would likely be futile. Prospects for rehabilitation depend upon many factors, and no dependable background factor is available for use as a basis of sampling for this variable.

After the independent variables were chosen, the problem arose as to a method of so controlling these factors as to assure the choice of a representative sample. With a single variable involved this would be easy. If we were sampling for percentage of all rural families, Negroes for example, all Cotton Belt counties could be thrown into an array on the basis of this percentage, and sample counties could be selected at intervals along the range of this series in proportion to the number of counties in each interval. Relief data, however, are related to many factors, no one of which alone could safely be used as a control.

In the procedure here followed, attempt has been made to control several factors simultaneously. The first controls were introduced at the outset of the problem by restricting the universe of units to be sampled to those counties in which one agricultural enterprise was dominant. Further controls were used in the actual selection of the sample. For the purpose of a special study, a sample of 32 of the 426 Eastern Cotton Belt counties was the largest which it seemed administratively possible to survey. In selecting that sample direct control was kept over four factors, namely, per capita land value, residence, tenancy, and the geographical distribution of the units. These gave indirect control over other related factors such as the per cent of rural families which are Negroes, and per cent of agricultural workers that are wage workers.

The method adopted for selecting these counties was based on the theory that relief factors are more likely to be controlled by combinations of variables operating jointly than by a series of variables operating separately. The technique followed was to record the necessary data on 3 x 5 filing cards. These cards were first thrown into an array on the basis of land value per capita of the rural farm population. This array of counties was divided into three equal groups representing units with high, low, and intermediate per capita land value. Each of these three groups was again arrayed and similarly divided into subgroups on the basis of the percentage of all farm operators that are tenants. This gave 9 subgroups, each of which in turn was again subdivided into thirds on the basis of the percentage of rural families that are farm families. This gave, in the end, 27 subgroups of the 426 Eastern Cotton Belt counties, there being 15 or 16 counties in each group. Then, in consultation with persons more or less familiar with the area involved, one county was so chosen from each of the subgroups as to give a geographical distribution roughly proportional to the number of cotton counties in each state.[1]

[1] It should be noted that the number of subgroups and the number of counties within each of these, may be varied to satisfy almost any size sample, of one county from each group, that may be desired.

This procedure gave a sample of 27 cotton counties, so chosen that high, low, and intermediate per capita land value, residence, and tenancy were included. Since 32 units were needed, to make a required 7.5 per cent sample of Eastern Cotton Belt counties, five additional units were selected in such a manner as to keep, as far as possible, the proper representation of all factors and combination of factors.

TABLE I

SCHEME FOR SELECTING CONTROLLED SAMPLE OF 32 OUT OF 426 COUNTIES IN THE EASTERN COTTON BELT, WITH NAMES OF COUNTIES SELECTED

		X_1	X_2	X_3
Y_1	Z_1	Winston, Ala.	Montgomery, Ark.	Cabarrus, N. C.
	Z_2	Conecuh, Ala.	Calhoun, Ala.	Pickens, S. C. Chattooga, Ga.
	Z_3	McDuffie, Ga.	Union, S. C. Allendale, S. C.	Pemiscot, Mo.
Y_2	Z_1	Lawrence, Miss.	Calhoun, Ark.	Madison, Tenn.
	Z_2	Calhoun, S. C.	Webster, La.	Mitchell, Ga.
	Z_3	Webster, Ga. Pike, Ga.	Natchitoches, La.	Concordia, La.
Y_3	Z_1	Winston, Miss.	Murray, Ga. Sharp, Ark.	Sampson, N. C.
	Z_2	Tippah, Miss. Heard, Ga.	Dodge, Ga.	Washington, Miss.
	Z_3	Macon, Ala.	Jenkins, Ga.	Morehouse, La.

X=land value per capita of the rural farm population.
Z=per cent of farm operators that are tenants.
Y=per cent of rural families that are farm families.
Subscript 1 indicates the lowest third of the 426 counties with respect to a given factor; subscript 2, the middle third; subscript 3, the highest third.

Table I indicates, in an abbreviated form, the scheme used for selecting this sample of 32 Cotton Belt counties. In its completed form each of the 27 cells of this table would contain 15 or 16 county names, there being a total of 426 counties. As here presented, only the names of the selected counties are given.

This may be done by changing the number of equal classes into which the separate arrays are divided, by changing the number of controlled factors, or by changing both of these. For example, if a 15 per cent sample of the 426 cotton counties were desired the arrays could be classed and subclassed on the basis of quartile groups, giving 64 subgroups, assuming three variables were used. If a sample of 48 counties were desired, the first two arrays might be divided into quartiles and the third, into thirds, giving 4 x 4 x 3=48, the proper number of groupings.

Any sample selected in this manner is necessarily representative, within broad classes at least, with respect to the several controls. Theoretically, these controlled variables should have low intercorrelations, for if two factors are highly correlated either one will furnish a control of the other. Actually, the variables which have been used as the bases of selecting sample counties in the cotton growing area, are not entirely independent with respect to each other. There is a considerable degree of correlation between per capita land value and percentage of tenancy. However, since each of these gives control of other important background materials, they were both used as bases of selection.

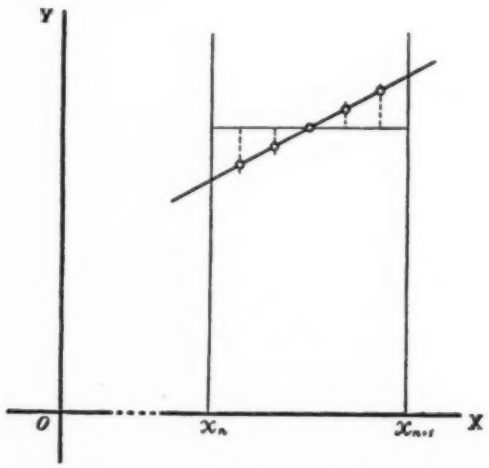
By the simple procedure described above, we have made our sample counties representative of a cluster of background factors which we have assumed are related to various aspects of rural relief. If these background factors are related to relief, then the sample should tend to be representative of the relief aspects. An examination of such rural relief data as are now available seems to bear out our assumption of dependence. For example, the 32 counties constituting our 7.5 per cent sample of the Eastern Cotton Belt contained 7.64 per cent of the rural households reported as on relief in this region by the October 1933 Relief Census. So close an agreement is not to be expected all of the time, but we have reason to feel considerable confidence in the validity of the sampling method employed.

PITFALLS IN THE COMPUTATION OF THE CORRELATION RATIO

By Jan K. Wiśniewski, *Polish Institute for Economic Research, Warsaw, Poland*

As everyone knows, the numerical value of the correlation ratio η is not independent of the classification of data. As the class intervals become narrower, η approaches 1, as they are wider, the value of η approaches that of r, the correlation coefficient.

A special and indeed puzzling case arises when we get $\eta < r$. Of course, the one and obvious possibility is that of an arithmetic error. The other one is of a more intricate character. The correlation ratio can only be calculated when at least the independent variable is grouped into class intervals, while the correlation coefficient can be found from unclassified data as well. Here is the source of error. If the class intervals are fairly wide, as they necessarily are in the case of comparatively scarce observations, the distribution of x, y points within each interval may not be purely random but show the influence of the underlying regression. If, then, the correlation coefficient r is calculated from unclassified data, this part of regression which shows itself *within* class intervals is also taken into account while in the calculation of η it is lost. Therefore, in order to get comparable values of r and η we should always compute both of them from basic data classified in the same fashion.



To make the point clearer we shall resort to a chart. Suppose in a certain x-array all x, y points are situated on the straight regression

line. Insofar, then, as we compute r from unclassified data the contribution of the given array to s in the general formula for a correlation measure $R=\sqrt{1-\frac{s^2}{\delta^2}}$ is nil. If we compute both r and η from data classified according to x only, that contribution becomes considerable and so η would be smaller than r computed in the first way. It should be noted that the computation of r from data grouped into classes with respect to one variable only tends to understate the degree of correlation, as $\sum_1^n x_i y_i > \frac{1}{n}\sum_1^n x_i \sum_1^n y_i$ for positively correlated x, y, while the effect of cross-classification may be random. So it seems that the following rule should be respected: When computing both r and η, use cross-classified data.

The subject matter of the present note has been dealt with in a somewhat different manner by Karl Pearson and student in *Biometrika*, Vol. IX, pp. 116–139 and 316–320. The author is indebted to Professor A. L. Bowley for a critical examination of the present note.

NOTE ON THE CHRONOLOGY OF STATISTICAL SOCIETIES

By Walter F. Willcox

In sketching the history of statistics disproportionate attention has hitherto been given to the work of individuals and that of commissions, bureaus, etc., while that of private and voluntary organizations has been neglected. A generation ago Mischler began to restore the balance [1] and more recently the work has been continued.

The latest issue of the *Allegemeines Statistisches Archiv* (Vol. 24, Pt. 2, 1934) contains an article by Dr. Wilhelm Henninger of Munich on "National Statistical Societies." It deals mainly with their development in all parts of the world but treats in greater detail a group of the oldest or most important, including the Royal Statistical Society, the Statistical Society of Paris, the German Statistical Society, the Association of Workers in German Community Statistics, the Hungarian Statistical Society, the American Statistical Association and the Mexican Society for Geography and Statistics.

Dr. Henninger's arrangement is by countries, but his material can easily be recast into an historical form. In view of the approaching centenary of the American Statistical Association it may be worth while to present from these sources, supplemented by a few others, a chronological list of statistical societies, the few printed in italics being the writer's additions. Where no date appears the year of foundation is unknown. The list lays no claim to completeness and no doubt many societies, especially defunct ones, have been omitted. Late in 1932 the Hungarian Central Statistical Office undertook an inquiry into this subject (*Revue de L'Institut International de Statistique*, I, Pt. 4, p. 66), but no results, I believe, have yet appeared. The writer would be glad to receive, either directly or through the Journal, any information which would help in perfecting the list.

Mischler states that statistical societies originated in returns made in France by the Physiocrats about the middle of the eighteenth century and imitated later by agricultural societies in several countries. These have been disregarded here; a number of them are mentioned in the *Encyclopaedia of the Social Sciences*, Article "Agricultural Societies" (1930).

1660 *The Royal Society*, to the president of which John Graunt in 1662 dedicated in part his "Natural and Political Observations," and which thus became the cradle of statistics in the present meaning of that word.

[1] Ernst Mischler, *Handbuch der Verwaltungs-Statistik* (1892), §§ 75–78.

1800–12 French Bureau of General Statistics.
1803–06 French Statistical Society.
(These short-lived French Societies were abolished and statistical publications prohibited by Napoleon.)
1818 Württemberg Society for Knowledge of the Fatherland; consolidated, 1822, with the Statistical Bureau into a statistical commission.
1825 A statistical society in London published "Statistical Illustrations of the Territorial Extent and Population, Commerce, Taxation, Consumption, Insolvency and Crime of the British Empire." In 1827 it took the name of the London Statistical Society.
1827 National Society of Statistics at Marseilles.
1829–48 French Society of World Statistics.
1831 Statistical Society for the Kingdom of Saxony.
1832 Revival of the French Academy of Moral and Political Sciences which had been suppressed during the Consulate, and with it a Section for Economics, Politics and Statistics.
1833 The British Association for the Advancement of Science, founded two years before, established a statistical section.
1833 Statistical Society of Manchester, which claims to be the oldest statistical society in the world.
1833 Mexican National Institute for Geography and Statistics.
1834 Statistical Society of London, now the Royal Statistical Society.
1836 Geographical Society of Frankfurt a.M. In 1854 it was changed to the present Society for Geography and Statistics.
1836 Deux-Sèvres Society of Statistics, Sciences and Arts.
1836 Isère Statistical Society.
1836 Glasgow Statistical Society.
1836 Glasgow and Clydesdale Statistical Society.
1836 Bristol Statistical Society.
Birmingham Statistical Society for the Improvement of Education.
1836 *New York Statistical Society* (apparently stillborn. See American Statistical Association, *Publications*, 14: 285 and footnote).
1837 Drôme Society of Statistics, Useful Arts and Natural Sciences.
Cher Society of Antiquities, History and Statistics.
1837 Ulster Statistical Society.
1838 Liverpool Statistical Society.
Other statistical societies were established in Edinburgh, Leeds, and Aberdeen; by the middle of the 40's nearly all had disappeared. "Begun with enthusiasm, they perished for lack of staying power" (*Annals of the Royal Statistical Society*, 1934, p. 75).
1839 American Statistical Association.
1841 Lübeck Statistical Society; later merged with the Statistical Bureau.
1846 Society for General Statistics (Germany), founded by Von Reden. Statistical or similar societies to collaborate with this central one were organized at Berlin, 1847, Stettin, 1846, Breslau, 1847, Hamburg, 1853, Kassel and Darmstadt (date ?).
1847 Dublin Statistical Society.
1850 Social Science Inquiry Society as a branch of the Dublin Society.
1853–78 *International Statistical Congresses.*
1855 The two Irish Societies were combined into the Statistical and Social Inquiry Society of Ireland.

1858 Netherlands Statistical Society.
1860 Paris Statistical Society.
1860 Hungarian Statistical Commission, introduced by the Hungarian Academy of Sciences. Three years later, when the Central Statistical Office was established, the Commission felt that its main object was realized.
1864 Swiss Statistical Society with its center at Berne.
1870 Basle Statistical and Economic Society.
1876 Tokyo Society for the Science of Statistics.
1878 Tokyo Statistical Society.
1879 Association of Workers in German Community Statistics.
1884 Statistical Institute of the Netherlands, designed to fill the place of a central statistical office.
1885 *International Statistical Institute.*
1889 Berne Economic and Statistical Society.
1901 Swedish Statistical Society.
1909 Egyptian Royal Society of Political Economy, Statistics and Legislation.
1911 German Statistical Society, organized as a statistical section of the German Sociological Society.
1920 Finland Statistical Society.
1922 Hungarian Statistical Society.
1928 Czechoslovakian Statistical Society.
1931 *Brazilian Statistical Society.*
1931 Japanese Statistical Society.
1933 Indian Statistical Institute.
1934 Statistical Society at Upsala.

ARE CONSUMERS BEING BURDENED BY MONOPOLIES CREATED BY THE NRA?

A luncheon meeting of the American Statistical Association was held on Thursday, September 13, 1934, at the Hotel Woodstock, 137 West 43rd Street, New York City. Twenty-one persons were in attendance. Mr. F. R. Hoisington, Jr., Economist of the International Telephone and Telegraph Company, presided. The topic for discussion was: "Are Consumers Being Burdened by Monopolies Created by the NRA?"

A. Anton Friedrich, Associate Professor of Economics at New York University and Economist to the Emergency Council of Consumer Organizations, took the position that such burdens *are* being cast upon the consumers. He contended that prices had been fixed under the codes for numerous products at levels higher than would otherwise have existed and that the result has been to lessen the volume of goods purchased by consumers. He presented statistics to show that physical quantities of goods sold by department stores decreased 9 per cent between June, 1933 and June, 1934, and that chain store sales fell off 8 per cent between July, 1933 and July, 1934. He held it to be obvious that shrinking sales meant shrinking production and more unemployment. In his opinion, price fixing is the essence of monopoly and nearly all codes provide, in one way or another, for the fixation of prices.

Mr. Byrnes MacDonald, Assistant Compliance Director of the Trade Practice Division of the NRA, insisted that the codes have established no monopolies, even though they do, in many cases, fix prices. He stated that the prices set by the codes have been established only after extremely careful research into the cost of producing the articles covered; that it is not feasible in any concern to maintain the standards set by the NRA and, at the same time, to sell goods below the code prices. The larger concerns usually live up to the provisions of the code. The smaller concerns, however, frequently violate the code provisions and sell at lower rates than those established by the code. They can do this and survive only because they engage in "unfair practices" such as reducing wages below the established levels. The fundamental principle of the NRA is that every employee must receive a living wage.

Professor Friedrich replied to this line of argument by asserting that price fixing is always evidence of monopoly. He ridiculed the idea that the code authorities had really learned much about costs of production before they fixed prices for products. In Professor Friedrich's opinion, it is practically impossible to ascertain costs of production for a particular product. He also raised the question as to why the most efficient concerns, which obviously would have low unit costs, should not be permitted to sell at low rates and absorb the entire market. He held further that it was an entirely legitimate form of advertising to sell certain articles below cost of production, if such sales attracted customers. He could see no reason for protecting inefficient producers from the competition of those having lower costs.

In reply Mr. MacDonald argued that the low-cost producers would hire fewer workers, would put out of operation the higher-cost concerns, and would, therefore, throw upon the relief rolls additional numbers of persons, thus adding to the burdens of the taxpayers.

The question was raised from the floor as to whether the lowering of costs, and hence of prices, would not either increase the volume of that kind or of some other kind of goods sold, and whether such an increase in volume of sales would not inevitably diminish unemployment. Another question was whether it ought to be the avowed policy of the Nation to protect inefficient producers and prevent the entrance into the field of new concerns using more up-to-date methods.

WILLFORD I. KING, *Secretary*

NOTE ON CORRELATION IN RANDOM SERIES

In Holbrook Working's recent paper in the JOURNAL on "A Random-Difference Series for Use in the Analysis of Time Series," the statement is made that "Even in a purely random series (one of random deviations from a norm) in which individual values are unpredictable, changes are predictable with considerable accuracy—the coefficient of correlation between absolute values in a random series and the immediate subsequent changes is $r = -.71$." This is a situation, however, in which the correlation coefficient can offer a deceptive impression of

prediction accuracy. Errors in prediction, as measured by the standard error of estimate, are precisely the same whether a particular random item is used to predict the next occurring value or to predict the difference between them. The coefficient of correlation is changed from $r=0$ in the one case to $r=-.71$ or $r=-\frac{1}{\sqrt{2}}$ in the other, solely because the standard deviation of the variable being predicted has been increased by the factor $\sqrt{2}$ in the second case.

Thus, if x_i is the deviation of any item, of a random series, from the mean, then the standard deviation of the series is $\sqrt{\frac{\Sigma x^2_i}{n}}$. Since there is no correlation between x_i and x_{i+1}, this is also the standard error of estimate when predicting the absolute values x_{i+1}. The standard deviation of the first differences, however, is $\sqrt{\frac{\Sigma(x_{i+1}-x_i)^2}{n}}$, which reduces to $\sqrt{\frac{2\Sigma x^2_i}{n}}$. Since the correlation between absolute values in a random series and their immediately subsequent changes is $r=-\frac{1}{\sqrt{2}}$, the standard error of estimate when predicting changes in this series is $\sqrt{\frac{2\Sigma x^2_i}{n}}\sqrt{1-\frac{1}{2}}$, which reduces to $\sqrt{\frac{\Sigma x^2_i}{n}}$, the same as when predicting absolute values. Hence, in a random series changes between successive items have the same error of prediction when predicted from immediately preceding items as have predictions of absolute values similarly made.

ALEXANDER STURGES
Bureau of Agricultural Economics

NOTE ON ESTIMATING SIGNIFICANCE OF A NUMBER OF SAMPLES

Professor Charles C. Peters has suggested that the probability that a number of samples are, as a group, significant, is equal to the product of probabilities that the individual samples, taken separately, are significant.[1] While Peters' insistence on the increased significance of a number of consistent results is valuable, the procedure suggested for estimating this significance is incorrect. To demonstrate this it is necessary merely to point out that it may be made to yield two quite different results in any given case, depending on whether one considers the indicated probabilities that the samples *are* significant or the indicated probabilities that they are *not* significant.[2]

In the case where we have two samples, indicating independently probabilities p and p' that the true value of a statistic is negative, it can be argued that pp' is

[1] "Note on a Misconception of Statistical Significance," *American Journal of Sociology*, Sept. 1933.

[2] Peters actually takes the product of the individual probabilities that the samples are *not* significant as the probability that the group is *not* significant, thus obtaining a very high probability of significance for the group as a whole. If he had used instead the product of the probabilities that the samples *are* significant, the probability of significance of the group as a whole would be less than that of any single sample taken alone!

the indicated probability that, in another similar pair of samples, *both* the values obtained will be negative, and $(1-p)\ (1-p')$ the probability that *both* the values will be positive. The sum of these two quantities is not equal to 1, there being also the possibility that one sample will yield a positive value, while the other yields a negative value. For this reason, we cannot take pp' as the probability that the *true value* is negative, since if we do, so we must by the same logic take $(1-p)\ (1-p')$ as the probability that the true value is positive, and since the probability that the true value is negative plus the probability that it is positive must be equal to 1.

Several fairly well-known methods of handling this type of problem are available. Perhaps the simplest of these is to express the value of the statistic yielded by each sample in terms of its own standard error, take the mean of the numbers so obtained, and express this mean in terms of *its* standard error.[1] The probability of significance can then be calculated exactly as though we were dealing with a single sample.

LORING WOOD

A LETTER CONCERNING THE IMPROVEMENT OF AMERICAN STATISTICS

The Editor, JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION:

Dear Sir:

Readers of the JOURNAL will be interested, I think, in the reply to a question which I recently asked Karl Pribram, formerly professor in the Universities of Vienna and Frankfort and statistician in charge of research at the International Labour Office. (Professor Pribram came to the United States on January 1, 1934, on a two years' appointment at the Brookings Institution.)

Question: "If you had $25,000 to spend for the improvement of American statistics, how would you use it?"

Answer: "The main weakness of American statistics is on the side of interpretation for which long and severe training is needed. You have in the Government offices hardly any statisticians trained, as we understand training in Europe, and you are not likely to have them until the country learns how much a thorough interpretation adds to the value of the figures.

"The fact which has struck me most in the United States after years of statistical work in Europe is the unevenness of your development. In some lines of statistics, but not all, you have developed research to a level higher than that reached anywhere else. This applies mainly to business statistics in the broadest sense of the term. European students, anxious to acquire a comprehensive knowledge about the methods of compiling, adapting and comparing time series and studying cyclical fluctuations in economic life or about the best methods in banking statistics or statistics of scientific management, are advised

[1] The standard error of the mean of these numbers will always be $1/\sqrt{n}$, where n is the number of samples, since the standard of error of each number, and therefore the expected standard deviation of the group of numbers, is by definition unity.

in Europe to go to the United States. In contrast with your leadership within those fields, most branches of Government statistics have been strangely neglected. There are a few efficient offices, Federal and state, which publish the results of comprehensive investigations, but the procedure in tabulating the material and, above all, in interpreting the results falls far short of the best in Europe. As a rule, the lines of each enquiry are determined by a consultative committee, selected from specialists outside the Government service. But the statistical data collected and tabulated need thorough interpretation. In Europe this is done by men trained in economics and statistics, who afterwards become Government officers. No similar group exists in the United States. You have two main classes of statisticians, unofficial scholars academically trained, and civil servants, these latter well enough trained in routine clerical functions but seldom able fully to grasp the meaning and implications of their own enquiries and results. Between these two groups there is no link and your higher education does not train statistical officers.

"The same reason checks any endeavor to experiment in a new field. In Europe efforts of this kind, instigated usually by the younger officials, are constantly made.

"The same difference appears also in municipal statistical offices, not a few of which in Europe are remarkable for the amount and quality of their output. Many European cities maintain a carefully selected staff of statisticians and helpers; in the United States municipal statistics are in a deplorable condition. About the legal and political difficulties responsible for this, I am in no position to judge, but fortunately that delicate problem lies outside the scope of your question. Clearly a far-reaching improvement might result if a number of trained young statisticians were available.

"At this moment there is a unique opportunity for bringing to the United States such young persons educated at German or Austrian universities and some of them experienced also in Government offices. They have lost the chance to earn a living in their native country or elsewhere in Europe. Whether this supply of trained persons can be used to satisfy your American need, but not your demand, is a question you can answer far better than I. But if I had that amount of money, I would organize an American Committee with the object of bringing some of these young persons to the United States and supporting them for a minimum period in the belief that they would do much to transform the need into a demand."

If any reader is disposed to contribute toward carrying out Professor Pribram's suggestion, I shall be glad to organize a committee which would disburse whatever money is made available.

Sincerely yours,

WALTER F. WILLCOX

PROCEDURE FOR RESEARCH COMMITTEES

As recommended by the Committee on Research on April 6, 1934, a code of procedure for research committees was approved by the Board of Directors of the Association on October 16, 1934, as follows:

(1) The committee year shall be from March 1 to the end of February of the following year, and the appointment of existing research committees is hereby extended to February 28, 1935.

(2) Research committees shall be appointed annually at a meeting of the Board following the annual meeting and preceding the beginning of the committee year, in order that a careful appraisal of work may be completed after the annual reports of the committees have been filed at the time of the annual meeting.

(3) The chairman of each research committee shall submit a tentative program of work to the Board of Directors on April 1 of each year, copies to be transmitted promptly from the office of the Secretary-Treasurer to the chairman of the Committee on Research.

COLLEGIATE TRAINING IN MATHEMATICAL STATISTICS

The following statement, drafted by a special subcommittee, has been unanimously approved by the Committee on Research of the American Statistical Association:

The Committee endorses the proposition that colleges and universities should be urged to provide courses in statistical theory and technique under the direction of mathematically trained teachers.

The Committee recognizes the value of statistics courses in which mathematics plays a minor part. The field of statistics is many-sided, and mathematical theory represents only one aspect of the field; but in the opinion of the Committee it is an aspect of such importance that it is desirable to provide more adequate training in our colleges than has heretofore been available.

An important reason for this attitude is that it is inadvisable for one to deal with certain mathematical methods and formulae which are already in fairly common use, unless one understands fully the underlying conditions on which they rest. Many of these conditions are mathematical in nature and certainly cannot be presented to students who have not already had a course in analytic geometry; they can be presented much more easily to students who have also studied the calculus.

The subcommittee which drafted the report on which the above statement is based, comprised Burton H. Camp (chairman), Harold Hotelling, Henry L. Rietz, Walter Shewhart, and Edwin B. Wilson. The Committee on Research includes representation from the principal subject-matter fields.

PROGRESS OF WORK IN THE CENSUS BUREAU

QUINQUENNIAL CENSUS OF AGRICULTURE

Preparations are being made for the mid-decennial census of agriculture, which the law provides shall be taken as of the first day of January, 1935, and cover the crop year 1934. In the northern tier of states the enumeration commenced late in November in order to complete the task before the winter set in, when deep snows, such as the enumerators encountered in 1925, might greatly delay the

progress of work. In other parts of the United States the enumeration will begin on January 2. While the 1935 census will cover practically all the major items of interest to farmers and business concerns, the schedule comprises only about one-third as many questions as were asked in the decennial census of 1930. This curtailment has been effected by covering only the major field crops and the principal fruits and vegetables, omitting questions as to farm machinery and farm facilities and some of the other details which were carried on the 1930 schedule. The schedule will include questions asking for the number of dwellings on the farm, and the number of these not occupied; the number of persons living in these dwellings; and how many of such persons were not living on a farm five years ago.

A school was organized in the Bureau of the Census for instruction in the practice and technique of taking a census of agriculture so that the graduates can be employed to visit, advise, and instruct the district supervisors, who, as in previous censuses, will be local men. About 100 selected candidates attended these classes, and of this number 40 were selected for field duty, each to have charge or supervision of 5 or 6 supervisors. About 25,000 enumerators will be employed for from 4 to 6 weeks in taking the census.

This census of agriculture, it is believed, will be of special interest, as it will give data measuring the effects of the drought damage done to crops, changes in yields, and the amount of crop failure, and will likewise record the results of changes brought about by the Agricultural Adjustment Administration in restricting the production of certain basic commodities.

The agricultural data secured will be of value also in connection with the numerous programs planned to remedy the maladjustments in American life, among which may be mentioned: Subsistence Homesteads, Marginal Land, Land Utilization, Soil Erosion, Farm Credit, Federal Power Survey, the Farm Housing and the Farm Labor and Unemployment programs.

CENSUS OF MANUFACTURES

Although the manuscript for all industry reports for the census of 1931 was ready by the end of June, 1933, it was October 3, 1934, before the last of these reports was printed. The first was printed about May 5, 1933. The series of preliminary mimeographed reports by industries was completed and distributed by December, 1932. The copy for the complete report of the manufactures census of 1931, an octavo volume of 1,325 pages, for the printing of which, as explained in the September issue of the JOURNAL, supplementary funds were secured, has been sent to the printer and should be published before the end of the year.

Meantime preliminary reports for the census of 1933 are being issued, and the series will be completed by the time this issue of the JOURNAL is printed.

CENSUS OF AMERICAN BUSINESS

The results of the census of American business are being published in three series of mimeographed releases—one relating to retail trade, another to wholesale trade, and the third to service establishments, places of amusement, and hotels. The items covered by these releases include number of stores or estab-

lishments, total sales or receipts, number of proprietors, total payroll, part-time payroll, and the number of employees full-time and part-time separately given by months. These series of releases will be completed some time in November, or before the publication of this issue of the JOURNAL. Other tabulations are in progress showing credit sales (independent stores, branch systems, chains, etc.), total sales by kind of business and type of operation (distinguishing independent stores, chains, etc.), and by size of establishment. The results of this tabulation should be ready for publication in the early part of the calendar year 1935. The plan is to complete all the tabulations and compile all the tables by the end of May, 1935. There are no funds available for printing the reports; but an estimate of the amount needed is to be submitted to the next Congress.

THE TAX DELINQUENCY STUDY

The collection of data for the study of tax delinquency, mentioned in the March issue of the JOURNAL, has now been completed and a series of press releases has been issued showing for each of 62 cities the assessed valuation, the tax levy for the fiscal year 1932–33, and the amount of uncollected or delinquent tax by types of property, such as one-family dwellings, apartment houses, stores, vacant lots, etc., as ascertained by a sampling process; also a series of state press releases giving by counties so far as available the total general property tax levy and the amount uncollected; also three releases covering cities of over 100,000 population and showing for each city the total uncollected taxes on January 1, 1934 (or nearest available date) distributed by years of origin (*i.e.* years of tax levy), also the percentage of each tax levy remaining uncollected on that date and the percentage which the accumulation of unpaid taxes is of the latest tax levies. Another release lists by states the number and interrelationship of governmental units that levy property taxes. A projected study, begun but not completed, with but three news releases, shows the trend of tax delinquency by giving the amount and percentage of each tax levy from 1928–29 to 1932–33 remaining uncollected one or more years. For lack of funds no provision has been made for printing the results of this inquiry, nor has the material secured by it been fully exploited.

Conferences have been held to consider the possible continuation of the census studies on real estate taxation, the needs or demands for this kind of information, and the advisability of providing for the regular collection of data on the taxation of real estate by some one central agency, such as the Census Bureau. The principal conference was attended by representatives of the Federal Housing Administration, the Federal Home Loan Bank Board, the Reconstruction Finance Corporation, the Federal Administration of Public Works, and other governmental agencies or bureaus, one purpose of the conference being to find out whether these various organizations would have need for the data that would be obtained through such an inquiry. The Central Statistical Board was requested to conduct a survey of the needs for such statistics and of the present activities of the various federal agencies or quasi-public bodies in obtaining such types of data.

ALLOCATION OF BIRTHS AND DEATHS

As an outcome of a conference held in Washington on August 22 and 23, a special advisory committee on the allocation of births and deaths was organized consisting of the following state registrars: W. J. V. Deacon, of Michigan, Chairman; Joseph D. DePorte, of New York; W. Thurber Fales, of Alabama; and L. W. Hutchcroft, of Wisconsin. All these were present at the conference with the exception of Dr. DePorte.

As it has long been generally agreed that births and deaths should be allocated by residence and as the Bureau of the Census had decided to undertake such an allocation, the main question the committee had to consider was that of the best practicable rules and procedure to be followed in carrying out this decision. After discussing this question in the conference with representatives of the Bureau of the Census, the committee recommended that births be allocated by residence of mother, and deaths by residence of deceased, except that in case of deaths of new-born infants the residence of the mother should be considered the residence of the child; that residence for this purpose should be the "usual place of abode" as defined in the census of population; that beginning with 1935 the complete tabulation of births and deaths should be made on the residence basis; but that in order to preserve comparability with the statistics as heretofore tabulated total deaths and total births should be distributed both by place of occurrence and as allocated by place of residence.

The committee further recommended that the Bureau of the Census take steps to familiarize the state registrars with this proposal to use residence as the basis for its tabulation of births and deaths and assist them in instructing local registrars, physicians, undertakers, and hospitals as to the importance of reporting full data as to residence.

J. A. H.

MISCELLANEOUS NOTES

Changes of Editorship.—The publication of the September JOURNAL marked the retirement of Frank A. Ross as Editor, and of Leo Wolman as Review Editor.

Professor Ross has served nine years, Professor Wolman fourteen years. When the history of American statistics is written, important pages must be given to their influence, through the JOURNAL, in stimulating and directing the unprecedented development of statistical work since the World War. They have had their hearts in the task and have demonstrated that rare "sense of the significant" which is said to be the mark of an editor. Usually confronted with several times as many papers as could be published or several times as many books as could be reviewed, they have selected with especial eagerness those papers and books which pushed out new sectors on the front line of statistical application or more firmly consolidated the old. The JOURNAL has been a record of advance. Of the achievements which mark Professor Ross's editorship, perhaps the greatest was the inauguration of the volume of PROCEEDINGS, which summarizes the papers of the Annual Meeting and is mailed out promptly each year with the March issue.

The Acting Editor and Review Editor are just beginning to appreciate the problems with which their predecessors coped. While the widening heterogeneity of interests

in specialized statistical fields makes a central publication such as this JOURNAL more than ever necessary, it also makes the task of providing stimulation for all these interests in each individual issue more than ever difficult. Suggestions and frank, blunt criticisms are earnestly sought. The Acting Editor wishes to acknowledge the aid which he already has received from older and more experienced heads, and, above all, from Professor Ross and his wife and editorial assistant, Dorothy Ross, who have given many days of their time to an easing of the transition.

As in the past, the Review Editor will have independent charge of the Review section. All books for review and all correspondence relating to reviews should be directed to him.

Essays in Honor of Wesley C. Mitchell.—This year marks the sixtieth birthday of Dr. Wesley C. Mitchell, Professor of Economics at Columbia University, Director of Research of the National Bureau of Economic Research, and Past President of the American Statistical Association. In honor of this occasion seventeen of Dr. Mitchell's former students have prepared a jubilee volume of Essays in Economics and Statistics which will be published in December. The committee which has arranged and edited the volume consists of four of the contributors, Paul H. Douglas, Simon Kuznets, Horace Taylor, and Willard L. Thorp. The book is being published by the Columbia University Press.

The Cleveland Chapter.—The first meeting of the season for the Business Statistics Section of the local Chapter was held at the Hotel Carter on September 24. J. W. Vanden Bosch of the Cleveland Chamber of Commerce was chosen chairman of the group for the coming year, and J. H. MacKenzie of the Cleveland Federal Reserve Bank as secretary. The group made its semi-annual forecast of business activity for the coming six months. There was considerable diversity of opinion expressed, and it was decided that several meetings would be devoted to a discussion of the factors influencing business recovery.

The Philadelphia Chapter.—The final meeting of the Philadelphia Chapter of the American Statistical Association was held on May 18 and was devoted to Recent Developments in Social Statistics. Bernard J. Newman of the Philadelphia Housing Association discussed current studies in the social aspects of housing. Emmett H. Welch, director of research of the Pennsylvania State Emergency Relief Board, spoke of the state-wide unemployment survey. Interesting discussion from the floor touched upon other phases of social statistics.

At the annual business meeting, Dr. William J. Carson, assistant professor of Finance at the University of Pennsylvania, was reëlected President. Dr. Ewan Clague, Director of Research of the Philadelphia Community Council, was elected Vice-President.

The Pittsburgh Chapter.—Charles A. Carpenter, of the Bureau of Foreign and Domestic Commerce, was the speaker at the luncheon meeting held at the Harvard-Yale-Princeton Club on July 20. His subject was, "The Need for Coöperation in Gathering Statistical Information."

On August 23 the Chapter met, with Charles F. Durning, manager of the Pittsburgh office of the Hemphill Noyes Company, speaking on, "Possible Effects of Recent Security Regulation Acts on Stock Market Trends."

Bervard Nichols, editor of the *Pittsburgh Business Review*, was the principal speaker at the luncheon meeting held on September 27. His subject was, "The Business Outlook." M. W. Cooke, general superintendent of the Pittsburgh Railways Company, led the discussion which followed.

The San Francisco Chapter.—"Some Aspects of our Economic Emergency" was the subject at a dinner meeting of the Chapter held at the Bellevue Hotel on Wednesday evening, October 17. Dr. Normal J. Silberling, of the Silberling Research Corporation, made the principal address, in which he discussed the problem of the unemployed and some popular misconceptions concerning it, the importance of the debt burden and the problem of carrying on while it can be mitigated, dangers of minority or local groups exploiting the emergency financial and relief mechanism in order to put through schemes for immediate results regarding prices, private property, profits, etc., the administration program, what it is and what it is not, and the probable results for general business and investment. The subject was then thrown open for discussion.

Women's Bureau, United States Department of Labor.—In May, 1934, the Women's Bureau made an investigation of current pay rolls of the stemmery departments in three branches of the tobacco industry in Virginia and North Carolina to secure material for use in the making of a code for the tobacco industry. Pay-roll data for 3,990 persons were secured in the stemmeries of seven factories making cigarettes; for 418 persons in three plants making chewing tobacco; and for 717 persons employed by three dealers in tobacco. An overwhelming majority of the employees in stemmeries are women—the numerically most important occupation being hand stemming. As standards and conditions differ in these three branches of the tobacco industry, a separate analysis has been made for each group.

Striking variations were found in the amount of time worked in the three branches of the industry studied. In dealers' stemmeries, a branch of the industry which had not complied with the President's Reëmployment Agreement, 67.8 per cent of the employees had worked 55 or more hours a week. In cigarette stemmeries, however, 57.4 per cent of the employees worked 40 hours a week with only one employee working longer than this, and in chewing-tobacco stemmeries no employee worked as long as 40 hours. The fact that not far from half of the workers covered in the industry (44.8 per cent) were employed less than 40 hours a week—15.3 per cent even less than 30 hours—in a normal period gives evidence of an undertime condition in the industry which should be borne in mind in fixing the hourly rates for the industry.

Hand stemmers who are generally paid on piece-work rates had a higher median of hourly earnings in cigarette factories (27 cents) than in chewing-tobacco factories (24.7 cents) or dealers' establishments (11.9 cents). There were likewise wide variations in hourly earnings of individuals and from plant to plant. Though the median of the earnings of cigarette hand stemmers working the full 39 or 40 hours was $11, it was $6.50 for the undertime employees in cigarette factories, more than two-fifths of whom worked 30 and under 40 hours. While the median of the earnings for hand stemmers in dealers' plants operating on a 55-hour schedule was $6.55, for the undertime employees in dealers' stemmeries, half of whom had worked at least 40 hours, it was $4.40.

A summary of all workers, regardless of hours worked and branch of industry or occupation, shows over 10 per cent earning less than $5 a week, and 48.6 per cent, less than $10. Only a little more than one-eighth of the employees covered in the stemmeries visited earned as much as $12 during the week.

A survey of the relief situation in the tobacco manufacturing centers covered showed that relief had been necessary to supplement earnings of a greater number of workers still employed in the tobacco-products industry than of those out of work because of the seasonal nature of the industry. In one city roughly two-thirds of the families were receiving supplemental aid during April and May, 1934, while only one-third were receiving total relief.

In connection with the establishment of the Bureau of Women and Children in the Puerto Rican Department of Labor, for which the Federal Women's Bureau lent the services of an industrial supervisor, a survey of the island with special attention to home work in the needle trades was conducted in the winter of 1933–34, jointly by the Federal and Insular Departments of Labor. The data gathered, and now published by the Women's Bureau in bulletin form, were presented at hearings held at San Juan and at Washington to formulate a code for home workers in needle trades on the island.

Since the World War the needle trades industry in Puerto Rico has doubled, in some lines trebled, in value. Home work in this industry is of great interest to the mainland where the markets are flooded with Puerto Rican products covering a wide range of qualities and prices. In the present study 323 workers in 252 homes were visited. Most of the work was handled for the contractor or manufacturer by agents who distributed the work to the home workers. No contractor was able to give definite information as to how much the home workers received. The agents were given a certain amount of money for the job and it was left to them to make financial arrangements with the home workers, keeping what they could for themselves. Agents interviewed reported commissions averaging around 22 per cent, greatly reducing the home workers' earnings.

Dependence of the families on home work as their chief means of sustenance is shown by the fact that in 113 of the 252 households this was the only wage income during the week previous to the agent's visit. Bundles of household linen, cotton nightgowns, silk lingerie, handkerchiefs, infants' dresses and men's pants and shirts, are delivered to the home workers by the agents, and the time and earnings on the last bundle were used as a base in answering scheduled questions.

It is no wonder that when they could get work over half of the women sewed 8, 9, or 10 hours daily, many working extremely long hours, days, and evenings. In terms of 8-hour days, one-third of the women finished their bundles of home work in 2 to 4 days, one-third finished them in 5 to 8 days; all but four of the remainder took 9 days or more.

For this work earnings per bundle ranged from 10 cents or less to $4, the median being 65 cents. About one-fifth (19.2 per cent) earned less than 25 cents. Only 8 per cent earned as much as $2. Hourly earnings were extremely low. For 31.4 per cent of the women they were less than 1 cent, for 31.1 per cent they were 1 and under 2 cents, and for 31.4 per cent, they were 2 and under 4 cents.

The study issued by the Women's Bureau contains a further brief analysis of the current wages of factory workers in the five most important branches of the needle trades on the island: men's clothing, women's dresses, infants' and children's cotton dresses, handkerchiefs, and underwear. Summaries are also included of studies made by the Puerto Rican Bureau of Women and Children during its first year, 1933, covering the employment of women in laundries, stores, and canneries of the island; and analyses of a week's pay roll in the tobacco and cigar industry, straw-hat making and telephone exchanges.

United States Bureau of Labor Statistics.—Among the recommendations of the Winant board, which in September, 1934 made an inquiry into labor conditions in the cotton-textile industry, was one that a comprehensive survey should be made by the Bureau of Labor Statistics of earnings, hours, and occupations in that industry. Upon request of the President, the bureau undertook to make such a survey, the field work being started on October 1. The survey covered not only cotton textiles but also woolen, worsted, silk, and rayon. Other recent wage studies made by the bureau

dealt with the automobile workers in Detroit and with newswriters employed on daily newspapers, both of these inquiries being made at the request of the National Recovery Administration.

The new general study of consumption and money disbursements of wage earners and low-salaried workers was started in October. The appropriation available for the work this year is very limited, and, as a result, this year's activities will probably be limited to the southeastern and middle Atlantic states.

At the request of the American Engineering Council, plans are being considered for a study showing the changing status of the engineering profession during the depression, the work to be done in coöperation with the Council.

The bureau is issuing a series of short bulletins dealing with the proper procedure for the organization and management of various types of coöperative associations. One of these, relating to consumers' coöperative associations, has already been published (*Bul.* No. 598) and two others, relating respectively to housing associations and gasoline-filling stations, are in process of being printed.

Beginning in the latter part of 1934, the bureau plans to extend its monthly survey of employment and pay rolls to include employees of state and local governments. This is being done in coöperation with the United States Employment Service and its affiliated state employment offices.

Children's Bureau, United States Department of Labor.—*Institutional Treatment of Delinquent Boys.*—The study undertaken by the Children's Bureau of the results of institutional treatment of delinquent boys has been completed and the report has been written by Alida C. Bowler, until recently director of the delinquency unit of the bureau, assisted by Ruth Bloodgood, also of the bureau staff. This report will be published in two volumes and will be available for distribution in the near future. Volume I discusses in detail the methods of treatment employed by the five state institutions for delinquent boys in which the study was made. Volume II reports the findings as to the subsequent careers of 751 boys who had been under care in these five different institutions.

Study of Industrial Home Work.—The Children's Bureau is engaged in a study of industrial home work undertaken by the U. S. Department of Labor at the request of the National Industrial Recovery Administration. At least 1,000 schedules will be taken in the territory studied by the Children's Bureau, including Maine, Connecticut, New York, New Jersey and other centers in which industrial home work has been found to be a problem. The Women's Bureau of the U. S. Department of Labor is also participating in the study in other states and localities. Home-work industries to be studied will include those in which home work is still permitted and those in which it is regulated, as well as those in which it is now prohibited, information from the latter being obtained to show how the manufacturers and employers have adjusted their industries to the prohibition of home work. The information obtained in this study will cover hours worked and rates paid for home work, the children engaged in these occupations and other data which will provide a basis for dealing with this problem by the NRA.

Earnings and Standard of Living of 1,000 Railway Employees.—The Children's Bureau coöperated with the Bureau of Labor Statistics and the Women's Bureau of the U. S. Department of Labor in a study of the earnings and standard of living of 1,000 railway employees during the depression, undertaken at the request of 18 of the standard railway unions assisted by a technical advisory committee. Investigators from the three Federal bureaus together with those employed by the unions made the study in 18 localities chosen as representative of the major railway districts of the

United States, the 1,000 families interviewed representing as nearly as possible a cross section of the railway employees in the localities visited. Tabulations were made by the Statistical Division of the Children's Bureau and the preliminary analysis of the material was made by a member of the bureau staff. The final report, written by a member of the advisory committee, Professor Carter Goodrich, of Columbia University, was edited in the Children's Bureau and published as a joint report by the three bureaus of the Department of Labor. Differing in scope and purpose from many studies made during the depression in that it is concerned with hardships endured by the employed rather than the unemployed, the study analyzes causes of reduced earnings of railway employees and the effect thereof on family living standards. Text tables present figures on lost time, occupation and earnings in 1932, occupation in 1929 and percentage decrease in earnings in April, 1933, household income and number in household dependent upon this income, amount of life insurance carried by railway employees in July, 1929, and number of employees that had dropped or cashed in insurance since that time, amount of indebtedness incurred, and the percentage reduction in milk supply and in income since 1929. The report also contains case histories of individual families.

Bureau of Mines, United States Department of Interior.—The principal efforts of the statistical staff of the Bureau of Mines at present center around improvement and early publication of the *Minerals Yearbook*. The volume for 1934—1,154 pages in length, comprising 72 chapters on commercial minerals—was available for distribution in October and set a record in speed of completion and publication for a statistical volume of comparable size and completeness by a government agency. As compared with the 1933 volume, the reference value of the *Minerals Yearbook, 1934*, has been greatly facilitated by the addition of a complete index of 40 pages.

Current economic problems have focused attention on gaps in statistical information on employment, man-hours worked, and productivity per man-hour in many of the important mineral industries. With the exception of coal, complete information of this kind has never been compiled for other minerals. As an adjunct to the regular annual statistics, the Bureau of Mines is now compiling complete annual employment and productivity statistics for certain minerals; tabulations covering a 10-year trend in employment and productivity in the iron ore and mercury industries are included in the *Minerals Yearbook, 1934*. Similar compilations covering other minerals are now in process of preparation and will be released in mimeographed or printed form as rapidly as completed.

United States Department of Agriculture.—The Bureau of Agricultural Economics had six representatives at the Third International Conference of Agricultural Economists, held at Bad Eilsen, Germany, in the "Freestate" of Schaumburg-Lippe near Hanover, August 26–September 2, 1934: Dr. O. C. Stine, Dr. O. E. Baker, Mr. H. M. Dixon, Mr. S. W. Mendum, Dr. Arthur G. Peterson, and Mr. David L. Wickens. Three of these representatives were on the program and presented papers: Dr. Stine on "The Agricultural Situation in the United States"; Dr. Baker on "Some Agricultural Implications of the Population Prospects in the United States"; Mr. Wickens on "Agricultural Credit in the United States."

Following the conference in Ge~many, Dr. Stine traveled in Russia, Turkey, and the Balkan countries, making a study for the Bureau of Agricultural Economics, of bread grain supplies and of agricultural conditions in general affecting international relations with reference to the marketing of agricultural products in those countries.

The American delegation to the General Assembly of the International Institute of Agriculture, which convened at Rome on October 22, 1934, consisted of the fol-

lowing: Dr. R. G. Tugwell, Under Secretary of Agriculture; Dr. H. C. Taylor, American member of the Permanent Committee at the Institute; Dr. W. H. Stevenson, President of Iowa State College of Agriculture; Dr. L. G. Michael and Mr. Niels I. Nielsen, Agricultural Attaches, representing the Department of Agriculture respectively in Belgrade and Paris; and Dr. O. C. Stine of the Bureau of Agricultural Economics.

Mr. S. W. Mendum, after attending the conference in Germany, spent several weeks at the International Institute of Agriculture, assisting Dr. H. C. Taylor, in revising the statistical work in farm accountancy; and Dr. Stine expected to remain in Rome during part of November to assist Dr. Taylor with plans for the Institute work.

Revised index numbers of prices received by farmers for farm products since 1910 were presented by the Bureau of Agricultural Economics in September of this year as an improvement in representing changes in the prices of farm products of the United States. The revision was begun in 1931 to utilize the results of the 1930 Census and additional data provided by the Crop Estimating Service for making index numbers of farm prices more representative of the actual changes in the prices of all farm products. The principal changes are (1) the use of improved price series for dairy products and tobacco, (2) the addition of the prices of 20 products including a group of truck crops, (3) shifting the weights from the marketings of the 1918–1923 period to those of the 1924–1929 period, and (4) index numbers for each group of commodities are weighted in proportion to that group's contribution to total cash farm income whereas formerly the combined index of farm prices was computed from the weighted aggregate value for the 27 commodities used in that series.

A survey of the effect of the drought on the food and feed situations was made in the Bureau of Agricultural Economics, at the request of the AAA, for use in connection with the adjustment program. Reports entitled "Effects of the Drought of 1934 on Feed, Forage and Livestock" and "The National Food Supply 1934–35" were issued in October, 1934.

Bureau of Foreign and Domestic Commerce.—Upon the recommendation of the Business Advisory and Planning Council for the Department of Commerce, the Bureau of Foreign and Domestic Commerce has undertaken a study of internal debts in the United States. Dr. Horton, who has been on the teaching staff of the University of Michigan for the past seven years, giving courses in money and credit and public finance, will make the study under the direction of Dr. H. Gordon Hayes, Chief of the Division of Economic Research of the Bureau.

The Business Advisory and Planning Council, made up of approximately 60 nationally known business leaders, in a resolution adopted by the Executive Committee at its meeting on June 1, recommended that this study be made by the bureau.

The Twentieth Century Fund, Inc., in a study of internal debts in the United States for the year 1933, submitted a proposal for further study in this field expressing the conviction that this type of information represents one of the most seriously deficient fields of statistical data.

The study as proposed will include such topics as personal, corporate, public utility, railroad, insurance, rural, banking, and Government indebtedness.

It is proposed to conduct this study on an annual basis under the direction of Dr. Horton. The determination of the volume of debt, the dates at which they were incurred, and the experience in relation to the payment of interest and principal, defaults and readjustments, together with the current reporting of such data periodically in subsequent years, is deemed by the Council as being of great value to business men, students of our economic activity, and Government officials. It is felt that the

effect of long-term debts on general economic activity and thus on production and consumption is so important that a better knowledge of the situation is essential.

Progress of Work on National Income Estimates.—The United States Department of Commerce Economic Research Division, which prepared Senate Document 124, of the 73rd Congress, 2nd Session, National Income 1929–1932, has been revising the estimates presented therein and compiling estimates for 1933.

On the basis of special studies made by the Department of Commerce and other research agencies during the past year, and constructive criticisms received from persons using the previous study, a number of changes making for greater clarity of presentation and precision of estimates have been introduced. Data newly available from such sources as the Census of American Business, the Real Property Inventory, the 1933 Census of Manufactures, special Treasury Department tabulations and numerous state reports are being incorporated.

The basic importance of most of the new data, and the lateness in the year when they will become finally available, have caused a postponement of publication of the annual estimates until the end of the year. It is expected that preliminary summary figures for 1934 will be issued in May, 1935.

Work on a state distribution of the annual income estimates has been progressing slowly and is to be taken up more vigorously after the end of the year. Preparations are being made in conjunction with the Central Statistical Board to coördinate the various individual estimated items being prepared by different government agencies to build up a monthly index of the national income.

Developments in the Pennsylvania Department of Labor and Industry.—Recent developments in the administration of the Pennsylvania Department of Labor and Industry of particular general interest are the following:

Four-Year Report.—Departing from the traditional form of report, the Department has in the hands of the printer a readable, narrative report entitled, "Pennsylvania Labor and Industry in the Depression." It contains a wealth of factual information on the effects of the depression on labor and industry in the state. A modern form of cartography used in this report is the result of a technique developed by a group of unemployed architects in Philadelphia, working on a CWA project under the supervision of the Department. This new system has come to be known as "Sociographic." The report is expected to be available for distribution some time during November. It may be obtained from the Department of Property and Supplies, Division of Documents, Harrisburg, Pa.

Cotton Garment Industry Survey.—That the NRA has wrought great changes in the cotton garment industry, infamous as Pennsylvania's worst "sweated" industry, is shown in a survey just published. Comparisons with a similar survey made two years ago reveal that the NRA as it is now administered in this industry has attained its major objectives, but that those employers who refuse to be controlled continue to find considerable leeway for chiseling or otherwise violating both the spirit and the letter of the codes. The evidence gathered discloses that in the cotton garment industry, at least, the NRA has eliminated child labor, reduced the working hours of all employees, and increased the weekly earnings for the majority of the workers. On the other hand, it shows that employers who prior to the NRA refused to pay fair wages still find numerous subterfuges by which they can dodge the minimum wage provisions of the industry's code. The need of machinery to enforce code regulations where compliance has not been obtainable is evident from the facts disclosed.

Special Policing in Industry.—Recommending legislation to abolish the company-paid deputy sheriff system in Pennsylvania, the Commission on Special Policing in

Industry has made a report to Governor Gifford Pinchot. To insure against a substitute system, repeal of existing legislation and the enactment of new laws is urged. The Department actively coöperated with the Commission in its efforts to obtain all information pertinent to the question involved. Detailed facts and unbiased discussion and recommendations about the whole industrial police system have been laid before the Governor. The report is now in press and will be available shortly.

Mathematical Statistics at Columbia University.—A greatly enlarged program of teaching and research in mathematical statistics is being undertaken at Columbia University this year. Professor Felix Bernstein, founder and formerly head of the Mathematical-Statistical Institute of Goettingen, has been appointed Visiting Professor of Mathematics. Research under the auspices of the Carnegie Corporation is being conducted with Professor Harold Hotelling as director, with a view to clarifying the foundations of statistical methods and extending their scope, and particularly in the development of tests of significance and criteria of accurate estimation. For this work Dr. Joseph L. Doob has been appointed Research Associate, and Margaret H. Richards and William G. Madow Research Assistants.

A course of training in mathematical statistics has been arranged by the coördination of courses in the departments of mathematics, economics, and astronomy to dovetail together without overlapping. This work is designed for serious students familiar with calculus and higher algebra. It includes Probability, taught by B. O. Koopman; Statistical Inference, by Harold Hotelling; Mathematics of Heredity and Evolution, by Felix Bernstein; training in the use of card tabulating and calculating machines, interpolation and finite differences, by W. J. Eckert; Mathematical Economics, by Harold Hotelling; and a seminar in Advanced Mathematical Statistics. In addition there are at Columbia University numerous other courses in statistics designed for students in particular fields to which the theory is applied.

New Italian Journal of Population.—The first issue has recently been published of *Genus*, the official organ of the Italian Committee for the Study of Genetics and Eugenics. It is edited under the auspices of the National Research Council of Italy. The editor is Vittorio della Porta and the editorial office is at 10, Via Terme di Diocleziano, Roma. *Genus* will publish papers on population problems in Italian, French, German and English, and welcomes contributions from specialists in Demography, Sociology, Economics, Ethnology, General Biology, Eugenics, Genetics, Anthropology, Social Hygiene, Psychology and Geography.

Library of the International Institute of Agriculture.—The Library of the International Institute of Agriculture has recently been transferred to its new building in the gardens of the Villa Umberto I, near the Institute in Rome. The Library now has 270,000 volumes and receives 3,366 periodicals. It has made an effort to specialize in such topics as agricultural industries, rural economics, sociology, and agricultural statistics and legislation.

Y.M.C.A. Bureau of Records.—The National Council of the Y.M.C.A. has established a new bureau of records, studies, and trends, under the direction of Mr. Owen E. Pence. The bureau will engage in research relating to the programs, personnel, and administration of the constituent associations in the United States and Canada and will compile the statistical year book of the associations. The address of the bureau is 347 Madison Avenue, New York City. Dr. Arthur L. Swift, Jr., Professor of Sociology at the Union Theological Seminary, is chairman of the Advisory Committee of the bureau.

Committee on Statistical Reporting and Uniform Accounting for Industry.—As a result of its study of the statistical activities of the Department of Commerce in the field of business, the Committee on Statistical Reporting and Uniform Accounting for Industry has recently submitted a report to the Business Advisory and Planning Council for the Department of Commerce under the title "Reporting of Industrial Statistics." Pointing out that, in general, existing compilations of statistical data relating to business at quarterly, monthly, and more frequent intervals do not now provide a sufficiently well-balanced view of industrial operations for adequate analysis and interpretation of general business conditions by the public, the report presents the results of a broad survey of manufacturing and mining industries, and outlines specific suggestions as to types of monthly data which are felt to be needed. Persons who are interested may obtain copies of the report by writing to Mr. Donald R. Belcher, Executive Secretary of the Committee, 195 Broadway, New York City.

International Wage Comparisons.—Copies of a comprehensive report on the statistics of international wage comparisons may be obtained from the Social Science Research Council. This bulletin, which was issued in 1932, presents a critical review of the avilable statistical data, together with the reports of two international conferences. Ask for *Bulletin* No. 22, International Wage Comparisons. Request for copies of the bulletin should be addressed to the Social Science Research Council, 230 Park Avenue, New York City.

Personals

John O. Bergelin, formerly with the Public Works Administration, and Roland I. Robinson, from the staff of the University of Michigan, have joined the staff of the Division of Research and Statistics of the Federal Reserve Board.

Dr. Eugene T. Halaas has recently been appointed Assistant Professor in Economics in the University of Denver School of Commerce. Dr. Halaas was formerly Instructor of Economics at Drake University.

William J. Carson, Wharton School of Finance and Commerce, University of Pennsylvania, served as Acting Executive Secretary of the Central Statistical Board during the period July 2–September 18, in the absence of Morris A. Copeland, who was on leave for the summer session at Columbia University.

Edward R. Gray, who has been a staff member of the Central Statistical Board since November, 1933, has been appointed Assistant Secretary of the Board.

Walter R. Stark, until recently chief of the section of financial and economic research of the Treasury Department, has resigned that position and returned to the statistical service of the Federal Reserve System, undertaking special research.

Dr. Norris O. Johnson has become a member of the research staff of the Federal Reserve Bank of New York.

MEMBERS ADDED SINCE SEPTEMBER, 1934

Boddy, Francis M., Assistant in Economics, School of Business Administration, University of Minnesota, Minneapolis, Minnesota

Buros, Prof. Oscar K., Department of Education, Rutgers University, New Brunswick, New Jersey

Burtis, Edgar L., Student, University of Chicago, Chicago, Illinois

Chamberlin, Dr. Edward H., 14 Ash Street, Cambridge, Massachusetts

Colberg, Marshall R., Graduate Student, University of Chicago, Chicago, Illinois
Conant, Lawrence W., The Brookings Institution, Washington, D. C.
Connor, Lewis R., Statistician, Imperial Chemical Industries, Ltd., Millbank, London, S. W. 1, England
Decker, Fred J., N. Y. State Department of Civil Service, State Office Building, Albany, New York
Dorau, Dr. Herbert B., Associate Professor of Economics, New York University, Washington Square East, New York City
Fowler, Titus W., Central Hanover Bank & Trust Co., 70 Broadway, New York City
Griffin, John U., Student, Columbia University, New York City
Griffith, Donald T., Assistant to Harold A. Vogel, Idaho Land Planning Consultant, 630 Elm Street, Moscow, Idaho
Hanley, John A., NRA Commerce Building, Washington, D. C.
Hughes, H. Herbert, Assistant Chief, Mineral Statistics Division, Bureau of Mines, Washington, D. C.
Kemp, Dr. W. B., Departments of Genetics and Statistics, University of Maryland, College Park, Maryland
Leopold, Robert, Economics Section, American Telephone and Telegraph Co., 195 Broadway, Room 722, New York City
Lo, Chih-yu, National Research Institute of Social Sciences, Economics Department, Academia Sinica, Nanking, China
Mahony, Clinton R., Assistant Controller, Barnard Sumner & Putnam Co., 327 Main Street, Worcester, Massachusetts
March, James H., Certified Public Accountant, 18219 Cornwall Road, Cleveland, Ohio
Meacham, Alan D., Head of the Tabulating Department, University of Michigan, Ann Arbor, Michigan
Ocker, Edward H., Assistant Director Research & Statistics Division of the State Emergency Relief Board, State Capitol, Harrisburg, Pennsylvania
Orr, William E., Jr., Social Surveys, State Emergency Relief Board, Museum Building, Penn. State Capitol, Harrisburg, Pennsylvania
Perdomo, Manuel, Brokerage, P. O. Box 400, Havana, Cuba
Shields, George W., Auditor, Federal Chemical Co., 634 Stairs Building, Louisville, Kentucky.
Sullivan, John P., General Motors Corp., Room 2322, 1775 Broadway, New York City.
Vernon, Raymond, Statistician, National Bureau of Economic Research, 1819 Broadway, New York City
Wilcox, Francis E., Statistical Department, Household Finance Corporation, 919 N. Michigan Avenue, Chicago, Illinois

REVIEWS

The House of Adam Smith, by Eli Ginzberg. New York: Columbia University Press. 1934. 265 pp.

What bothers Mr. Ginzberg fundamentally is that while "the economic system of the eighteenth century has all but disappeared" (page 202), still "the attempt is constantly being made to study and reform the existing system with the tools which were developed to grapple with the old one" (page 203). His whole treatment of Adam Smith derives from his preoccupation with this idea. Adam Smith was a reformer who sought to alter the institutional arrangements of his day by removing the hand of special privilege and thereby releasing the productive efforts of a society. His tempered advocacy of freedom of enterprise was not doctrinaire but a realistic approach to the reforms desired. Since the world which Adam Smith knew was giving way even during his lifetime before the new industrial techniques, the relevancy of his message became rapidly obsolete. He continued to live as an active force in the world only because his libertarian views, charmingly clothed in apt and penetrating language, served the purposes of later generations of financiers and industrialists, the spiritual descendants of the classes whom he had so devastatingly exposed. "Adam Smith . . . was praised by the descendants of his enemies, and scorned by the descendants of his friends" (page 198). As ironical contemporary points of reference in dramatizing this point, Mr. Ginzberg takes President Hoover and Pope Pius.

Granting a certain and quite generally accepted element of correctness in Mr. Ginzberg's thesis, one cannot concur in the process of interpretation by which the half of the story of Adam Smith is made to equal the whole of it. In one question can be crystallized the whole point of controversy: Was Adam Smith's importance in the nineteenth century or is his importance in the twentieth century merely that he furnished capitalists with arguments against socially desirable limitations upon their freedom of action? Though the nominal topic is Adam Smith, what Mr. Ginzberg has really written about is himself. He displays clearly what he does not like about the capitalism of the machine age and rates Adam Smith in relation to those dislikes. By implication he either denies importance to nineteenth century economists because they were abstract thinkers and not reformers or gives them a sinister importance in so far as they too furnished support to the enemies of reform. In brief, Mr. Ginzberg has no criteria by which to judge the importance of economists except his own subjective standards of reform. He strikingly illustrates Professor Carl Becker's observation that men write the history of the past in terms of their own interest in the present.

What Mr. Ginzberg has no feeling for is intellectual history. Why do men still read Aristotle? Has his *Politics* lost all virtue since the world is no longer dotted with city states? Is Hobbes negligible because Stuart kings are obsolete? Is Locke unimportant because he wrote from the standpoint of pre-

democratic politics, pre-capitalistic economy, and pre-evolutionary psychology? Do great minds live only because they serve an economic interest? Penetrating observations upon the conduct of mankind are not frequent, and in their rare higher manifestations, however dated, they refuse to become utterly obsolete. This is not, however, a sufficient observation upon Adam Smith. The first two books of the *Wealth of Nations* impregnated the whole subsequent history of economic theory. They were germinal. They can be discounted only by discrediting the whole body of later thought with which they are associated. This is possibly what Mr. Ginzberg intends. There are other bright young men who do.

One abridger of the *Wealth of Nations* gutted it by quoting only its abstract theoretical passages. It is equally a serious blunder to make it into merely a tract of the times.

PAUL T. HOMAN

Cornell University

Miners and Management, by Mary Van Kleeck. New York: Russell Sage Foundation. 1934. 391 pp.

The Russell Sage Foundation has for a number of years undertaken to study outstanding experiments in worker-management coöperation. Coal mining has received from the Foundation more attention than any other industry. Ben M. Selekman and Mary Van Kleeck published in 1924 a survey of the industrial relations plan of the Colorado Fuel and Iron Company (*Employe Representation in Coal Mines*). In 1931, an investigation was made of collective bargaining in the Illinois coal fields (Louis Bloch: *Labor Agreements in Coal Mines*). The present study is concerned with the labor relations of the Rocky Mountain Fuel Company of Colorado. Unlike its predecessors, this volume attempts not only to summarize the operations of a particular company or district but to outline for the coal industry as a whole a plan for remedying its long-standing evils. We thus have really two books in one: the first, a very adequate description of the six years of joint negotiations between the Rocky Mountain Fuel Company and District Number 15 of the United Mine Workers; and the second, a summary of what might be done for the mining industry. Altogether, it may be said that the volume is an exceedingly significant contribution to our economic literature. Its charts, prepared by the Mundaneum Institute of Vienna, are especially effective.

The Rocky Mountain Fuel Company was faced in 1928, in common with other Colorado coal mines, by a strike led by the I. W. W. In the course of this bitterly-contested struggle, the state police fired into a parade of the miners of the Rocky Mountain Company, killing several. Miss Josephine Roche, a minority stockholder, gained control of the Rocky Mountain Fuel Company through stock purchases and, much to the chagrin of her competitors, entered into a collective agreement with the United Mine Workers of America. This agreement was not of the traditional sort. The company secured in exchange for a guarantee of higher wages, steadier work, and the amicable adjustment of grievances, a

promise of coöperation from the workers to lower costs and advance productivity. The greater share of the five-year period which has followed has been marked by conflicts in which Miss Roche, the United Mine Workers and coöperating committees of the Colorado Federation of Labor have been pitted against competitive coal mining companies and unsympathetic banking groups. The most powerful mining competitor has been the Rockefeller-controlled Colorado Fuel and Iron Company. Thus far, the battle has favored the Rocky Mountain Fuel Company, which has increased its percentage of tonnage in the Colorado field and has continued to meet the interest on its heavy bonded indebtedness despite a persistent financial boycott and the heavy wage cuts of competitors. At one especially difficult time in 1931, miners employed by the company lent half of their wages to the Company during a two-and-a-half-month period.

Although joint agreement has been successful in maintaining a somewhat higher wage than that of competitors, it has not ironed out all of the grievances of the employes. The company when in difficult straits abandoned its "share-the-work" policy in certain mines without employing the joint machinery. This gave rise to a considerable feeling of resentment. Stability of employment, though improved, has in fact been not at all complete.

Much more significant than her description of the Rocky Mountain Fuel Company policies is Miss Van Kleeck's fifty-page digest of the problems of coal and their solution. Grave doubt is expressed whether the NRA will prove the remedy for the basic ills which afflict the industry. The National Bituminous Coal Industrial Board faces the same problem of over-capacity that prevailed before its establishment. The same system of differential wages between North and South is perpetuated. Furthermore, the industry is but one part of an unplanned economic system.

The solution proposed by the writer is not one of having the government, as at present constituted, take over the mines. She considers the government to be "not a supreme power able to hold the scales of justice in favor of greater efficiency or social righteousness but . . . on the contrary . . . dominated by the strongest power among the conflicting interests which make up the community." Her solution is to have technicians operate mining, in common with other industries, as a coördinated unit. Such technicians are, however, to be subject to a social ownership under which "workers be given dominance over the machine by collective ownership, thus setting free not only the workers but the rest of society which then becomes a workers' community."

It is heartening to read a volume which treats the mining industry as a part of an ill-functioning economic system rather than as an isolated case of breakdown. Possibly much of the grief which has developed under the codification of industry may be traced to the desire to solve the problems of specific industries rather than to seek more basic causes of the collapse. Miss Van Kleeck proposes socialization of basic industry under workers' control. She has made an excellent case for this position.

COLSTON E. WARNE

Amherst College

American Treasure and the Price Revolution in Spain, 1501–1650, by Earl J. Hamilton. Cambridge: Harvard University Press. 1934. xxxv, 428 pp.

The historian and students of prices owe a great debt to Professor Hamilton for throwing light on a chapter of monetary history that has hitherto been treated by generalizations. His investigation, which required years of residence in Spain, deals with general price levels, individual prices, money and real wages under two sets of conditions—first the great influx of American treasure into Spain (some 447,820,932 pesos) and secondly the inflation which resulted in Castile from the introduction of an inferior coin made of copper, called vellon, as well as the silver inflation in Valencia.

Professor Hamilton's data constitute a splendid lesson in resourcefulness. They were derived from the accounts and records of charity hospitals and to some extent from records of monasteries, convents, kitchen accounts of colleges, and those of the royal household, municipalities, and cathedrals—all in manuscript form.

The statistics show that the Price Revolution started at the opening of the sixteenth century and that the price level rose on an average of 51.5% in the first quarter of the century. In the entire first half of the century prices slightly more than doubled. "The order of regional emergence of the Price Revolution was in strict accordance with *a priori* expectations. The increase in prices during the first half of the sixteenth century was greatest in Andalusia, where the bulk of the early receipts of American gold and silver first entered circulation. New Castile, the region in the closest commercial contact with Andalusia, experienced the second greatest price upheaval. Valencian and Old Castilian prices rose similarly but lagged considerably behind those of the other two regions" (p. 192).

In the third quarter of the sixteenth century prices rose 49.5% and almost 100% during the half century. "That the advance of prices during the second half of the century so nearly duplicated that of the first half is indeed a remarkable coincidence" (p. 201).

During the last fifty years of the period under study, Professor Hamilton finds the influence of vellon and silver inflation and an average price level approximately 38.7% higher in 1650 than in 1625. "Hence the net advance under the stimulus of vellon inflation in Castile and silver inflation in Valencia in the second quarter of the seventeenth century was not far behind the most violent upheaval of silver prices in any quarter-century of the Price Revolution" (p. 220). The writer is not blinded by his thesis, however, and recognizes other causes of price advance besides American treasure and inflation and he does not fail to mention the fact that prices were rising in France and England during the period.

In addition to the movements of the general price level, the author also considers price changes in numerous commodities. Among them are to be noted forest products such as charcoal, ashes, firewood, turpentine, pitch, and resin; poultry products such as eggs, hens, and spring chickens; animal products such as beef, butter, tallow and tallow candles, cheese, lambs, lard, milk, mutton, fresh and salt pork, veal, wool, and sheepskins; five kinds of fish; spices such as cinnamon, cloves, pepper, and saffron; building materials including bricks, lime,

plaster of Paris, nails, pitch, roof-tiles; many kinds of fruits and nuts as well as such grains as barley, rice, rye, and wheat.

Wage data cover records for from fifty to a hundred grades of labor and the earnings of hundreds of workers. From hospital records wages were obtained for physicians, surgeons, attendants, legal counsel, superintendents, accountants, notaries, various classes of domestic servants, and other types. The wage index for 1591–1600 was 96.25% above that for 1541–1550. "The complete lack of data concerning the fluctuations of employment renders impossible an exact determination of the effect of the Price Revolution of the sixteenth century and the inflationary rise of prices in the second quarter of the seventeenth upon total labor incomes" (p. 274).

Measured in real wages, the "financial status of the average urban worker was approximately one-fourth less favorable in the last than in the first quinquennium of the sixteenth century. . . . Thus we find that the great streams of treasure from the Indies, which, according to the prevailing mercantilistic philosophy, were expected to enrich Spain after the fashion of King Midas, spelled unremitting economic retrogression for wage earners, one of the largest and most necessitous social classes." But then Professor Hamilton continues, "It seems, however, that Spanish workers fared infinitely better during the Price Revolution than did those of England, France, Germany, and Poland" (pp. 280–1). The author does not explain this second statement which seems to qualify his first so seriously. Does it suggest that the mercantilistic treatment of treasure had merits or that laborers benefit under violent inflation?

The book is written in an interesting style and the author is commendably critical of his own data. We note, however, a weakness for using less familiar words and expressions—"ubiquitous paucity," "lacunae probably vitiate," "inedited," "as limned by the data," "preconized," "bating"—which together with detailed footnotes which sometimes prove annoying suggest an attempt to appear scholarly. This is unnecessary. The work is scholarly and needs no trimmings. There is one footnote on page 46 in which vellon, the key word to much of the book, is defined. The reader who overlooks this definition remains at sea through the remainder of the book. Another reaction of the reader is that he is too often reminded of the hugeness of the author's task—that 2,700 hours were used for this, 30,750 for that, lack of heat, inadequacy of the lighting, etc.

The author devotes seven of his thirteen chapters to an explanation of how the treasure was brought from the New World and the elaborate precautions taken against loss from robbery, dishonesty of sailors, smuggling, and export. Included also are instructive chapters on Castilian and Valencian money which make clear the problems of inflation in Part II of the book. At this point the author discusses his sources and his methods and adds a chapter, which though highly informative, does not bear enough relationship to the whole to be included. He probably realizes this because, as he states in a note on page 152, "the possession of incomparably more original data than anyone has yet employed, together with the conviction that all systematic observations of perplexing phenomena encountered in pioneering price studies should be made available to economists, statisticians, and historians, amply justifies this present chapter."

In addition to thirty tables, twenty charts, and four illustrations, the book contains about a hundred pages of appendices showing method and data. The volume constitutes Number XLIII of the Harvard Economic Studies.

ASHER ISAACS

University of Pittsburgh

The Effect of Size on Corporate Earnings and Conditions, by William Leonard Crum. Harvard University, Graduate School of Business Administration Business Research Studies, No. 8. Boston: Harvard University, Bureau of Business Research. 1934. 32 pp.

This monograph analyzes the balance sheet and income account data, classified according to the size of corporate assets, contained in the Treasury Department's *Statistics of Income* for 1931. To all workers in the field of corporate earnings, the study will be as welcome as the basic size classification itself, which the Bureau of Internal Revenue has just published for the first time.

Professor Crum's findings are of great interest; but before sketching them it is appropriate to indicate some of their limitations, of which the author is fully aware and to which he gives perhaps even more attention than necessary. The data are for only 1931, therefore conclusions may apply only to that single depression year. The computed ratios are averages, and adequate internal evidence is not available to show that they are all typical averages. The industrial classifications employed (*e.g.* manufacture as a division, split only into major groups such as foods, metals, textiles) are very broad, and each embraces so many heterogeneous categories that a considerable risk is run if all characteristics found to exist for the whole are imputed to its components.

Within these limitations, what are the findings?

The larger corporations in general received a higher rate of return on their gross volume of business (more strictly, on *gross receipts*) than did the smaller. "Larger" and "smaller" refer to the nine class intervals employed in the *Statistics of Income* frequency distributions:

Total assets of
Under $50,000
$ 50– 100 (000 omitted)
100– 250 "
250– 500 "
500– 1,000 "
1,000– 5,000 "
10,000–50,000 "
$50,000,000 and over

But this correlation is not perfect. Indeed, in some major manufacturing groups, interpretation of the figures is doubtful: ". . . the differences . . . are striking . . . but serious question arises whether the movements of the curves reflect any correlation between profitability and size . . . other than an illusory correlation caused by heterogeneity of industrial classification" (pp. 10–11;

the reviewer has greatly abridged the passages from which these observations are quoted).

Here is as honest and as objective qualification of a statistician's results, voluntarily essayed by the statistician himself, as the most severe critic could desire. In this respect, the brochure under review sets a model for those "investigators" whose enthusiasm over coefficients of correlation and decimal point differences so often leads them to quick and complacent conclusions.

The computation of net return upon net worth shows somewhat different results. To be sure, lumping all manufacturing corporations together, the rate of return shows some general tendency to become larger as the size of the corporation increases (Table VI, top section, third column of figures). For the year 1931, this aggregate return for all manufacturing corporations is negative; but the rate of net loss on capital declines as the size of assets increases. But Crum properly does not emphasize this result, for the average figure for *all* corporations in *all* divisions in such a year as 1931 is a very hybrid abstraction. More significant are averages for the corporations that had positive earnings ("income corporations") and those for the companies that suffered losses ("no-income corporations"). Here the findings are conclusive and important: " . . . on the average, very small corporations *either* earn a very substantial return, *or* suffer a very severe rate of loss, on their net worth, whereas the rate of profit and the rate of loss are *both* more moderate for the larger corporations" (p. 14, italics the reviewer's). To give specific figures, the "income corporations" with under $50,000 assets earned 11.80 per cent; the "no-income companies" of this size suffered a loss of *52.79* per cent. On the other hand, the companies with assets of over $50,000,000 that earned profits showed an average return of only 6.86 per cent, while those with deficits lost but *3.65* per cent.

Many other derived figures appear in the study—ratios and averages concerning inventories, cash, capital assets, total debt—that accountants and financial analysts will find of great interest. Thus from a so-called "practical" point of view the study will command attention. From a scientific point of view, it deserves far more than ordinary commendation for its temperateness of statement, its care in drawing conclusions, its ruthless rejection of its own computed "statistics" when they seem based on inadequate classifications, on shifting sands of assumption, or on samples too small to be significant. Such honest assaying of both basic and derived governmental figures is valuable for many reasons, not the least of them being that it helps to stimulate further improvement in the basic data themselves.

RALPH C. EPSTEIN

University of Buffalo

The Economics of Free Deals, by Leverett S. Lyon, assisted by Helen May Wheeler. Washington, D. C.: The Brookings Institution. 1933. xv, 219 pp.

The "free deal" is defined "in a general way as an offer, or a giving, of something for nothing contingent upon the purchase of goods or services at a price."

It is significant as a market phenomenon in the field of branded, standard-price products, and at all stages of the marketing process. Deals may be offered by various types of sellers; to various types of buyers; on several different bases (direct-buying, indirect-buying, and selling deals); in terms of different types of goods, services, or monetary considerations; over different dimensions (time, quantity, area, and value); and for products which are either unfamiliar or established in the market. Data obtained from an elaborate questionnaire submitted to members of the Associated Grocery Manufacturers of America and of the National Wholesale Grocers' Association are classified in these respects and made to yield an exhaustive and illuminating description of the deal in all its manifestations.

Among the conclusions reached as to the economic significance of free deals, the most important is that they provide an element of elasticity in an otherwise more rigid price structure. An alternative view would stress the increased incentive to price or quality competition which would undoubtedly be provided by the elimination of deals. Since the issue as to whether the price structure would be more or less rigid if deals were abolished cannot, in the nature of the case, be resolved by either statistics or logic, one must be grateful at least for an informed judgment on the matter.

Upon another point the evidence appears conclusive. The seasonal influence is important in timing deals, and it is clearly an influence towards accentuating rather than diminishing the seasonal fluctuations in business activity. The peaks are higher and the troughs deeper because the line of least resistance is followed by offering deals at times when buyers are inclined to purchase more heavily for other reasons. The deal "is not used as a stabilizing device."

The evidence seems to point unmistakably also towards the unpopularity of deals with those to whom they are offered. "Speaking as deal recipients, 87 per cent of the reporting grocery wholesalers objected to deals because they engender confusion regarding costs." Inquiry into the attitude of ultimate consumers towards deals was not within the scope of the study, but it is well pointed out that "the diversion of attention from the articles to be purchased to something else cannot fail to render either the trade or the domestic buyer less capable of comparing the cost of the article under consideration with the cost of competing articles." The "deal-givers" profess to believe that their customers "enjoy being 'fooled.'" However, since they do not offer them the alternative of a price which is lower than the standard by the value of the "premium," the issue is not tested in the market place. There appear to be good grounds for thinking that here, as perhaps elsewhere in this field of monopolistic competition, demand has much less force than is commonly supposed in governing what kind of "products" sellers put upon the market.

The study is frankly addressed in part to the trade which coöperated in supplying the information, and the student of public policy cannot help being disappointed that the social implications of the problem do not come forth more prominently. "Deal strategy," for instance, is discussed from the point of view of effective selling, and "cost factors" are taken up only with reference to the effect of deals upon the total net profits of the seller who offers them. The

suggestions for code-makers, with which the book is brought to a close, are mostly warnings against ambiguities of phraseology and against provisions which might work an effect other than that which was intended by the trade group in question. Perhaps, after all, this is but a realistic appreciation of the manner in which the codes were drawn up.

EDWARD CHAMBERLIN

Harvard University

Public Utility Valuation Reproduction Cost as a Basis for Depreciation and Rate-Base Determination, by Willard J. Graham. Chicago: University of Chicago Press. (University of Chicago Studies in Business Administration, Volume IV, Number 3.) 1934. 95 pp.

Public Utility Valuation is an atavistic defense of the reproduction-cost method of determining the rate-base in public utility regulation. By neglecting certain fundamental considerations and without either new ideas or the statistical furbishing of old ones, Professor Graham has built his case—an *ad hoc* frame for a simple accounting suggestion. The laudable desire for consistency in rate-base and depreciation practice leads him to espouse an accounting procedure that will be adaptable to reproduction-cost methods. The plan involves no departure from orthodox practice in so far as property accounts, the "regular" depreciation reserve, and replacements and additions are concerned. But there will be set up an additional "'special' reserve for depreciation" in which any excess (or deficiency) in the regular reserve resulting from price changes as measured by an index number of construction costs will be recorded. This balancing account would be utilized only in the determination of the rate-base. From reproduction-cost new would be deducted the sum of the regular and the "special" depreciation reserves, together with certain other reserves, to ascertain the depreciated rate-base. Professor Graham's faith in the efficacy of index numbers (for the calculation of both the rate-base and the depreciation reserve) to remove the obstacles of time, expense, confusion, and litigation commonly associated with the reproduction-cost method is disquieting for the student of public utilities, especially in the light of his admission that the adequacy of their use must vary inversely with the length of time between the acquisition of property and the date of inquiry. Not only the necessary "revaluations" every five or ten years (which he admits) but also the concentration of conflicting interests upon the selection and weighting of factors to be included in the index, the choosing of price samples, and the applicability of a general index to a particular utility (difficulties which he presumably does not recognize) undermine the confidence of the more timorous. Despite these and many other of objections, Professor Graham's suggestion would still be an improvement over present diverse practice could we assume that the reproduction-cost method was either legally inevitable or economically desirable.

Professor Graham is too acute to waste time over legalities. If a method is economically justified time may be expected to bring necessary legal changes, even if an amendment to the Constitution is required. Rightly, too, he appreci-

ates that once a plan of regulation is definitely adopted, the determination of the rate-base is not a matter of "fairness" or of "equity," but of the ability of the utility to get adequate capital in the market on reasonable terms. Thereafter investors are forewarned, and regulation is therefore an economic, not a judicial, problem. This position represents a commendable beginning. Unfortunately, Professor Graham does not adhere consistently to it (compare pp. 3, 9, 10 with pp. 15, 55). From here on he does not escape the pitfalls of the variegated literature of public utility regulation. Ignoring the economic basis of the "unique" quasi-monopolistic position of public utilities, its effect upon the capital market, and the consequent objectives to which regulation should be dedicated, he assumes that "competitive "price is the ideal and, even more dubiously, that reproduction-cost is an adequate means of attaining that competitive price. By failing to appreciate the requirements of effective regulation (no matter what the rate base) over security issues, plant extensions, accounting, and service, he does not consider the relative feasibility of alternative methods of rate-base calculation. And by the implicit assumption that the rate-base *fixes* service rates rather than constituting an earning base only (a point to which he pays lip service on p. 3), he disregards factors determining class rates and seeks, through the rate-base, a *formula* for regulation that will dispense with the exercise of judgment. This leads him to give inadequate consideration to the prudent investment method.

In defense of reproduction cost, Professor Graham resurrects two major arguments. The one, that the method will assure more stable "real" earnings, is introduced, despite an admission that, practically, "it will probably be easier to control prices and prevent fluctuations," and without one iota of proof that such a condition is necessary to secure adequate capital. Cognizant that the capital structure of utilities, even were the index number used perfectly correlated with "purchasing power," would prevent the attainment of this objective, he justifies his advocacy of manipulation of the rate-base rather than the rate of return by the naïve contention that no *extra* speculative risk is placed upon public utility stockholders than is borne by other types of common stockholders. If such a speculative character is unsatisfactory, he suggests that this may be an indictment of the narrow common-stock equity (which is the natural result of security based upon the "unique" position of public utilities) rather than the reproduction-cost method (which is an artificial injection into the situation). Without an attempt to analyze available data upon cost of capital under prudent investment and reproduction-costs, he resorts to a theory advanced for such industries as gold mining (where the aleatory gains may be great) to bolster his contention that the introduction of this highly speculative character into public utility stocks may actually *reduce* the cost of capital!

The second major contention is that the reproduction-cost method will constitute an effective incentive to management to expand plant during low-cost periods. This hackneyed argument might be subjected to statistical check, but no such proof is offered. At one place (p. 7) he notes the inability of *economists* to predict the future trend of prices, at another (p. 17) that construction indexes show that more construction takes place in high-cost periods than in low-cost

periods (despite the operation of the profit motive), and yet he concludes that the incentive to profit will lead to public utility extensions during low-cost periods. This neglect of obvious considerations—that plant investment is more responsive to demand than cost, that demand for public utility services is conditioned more nearly on general business conditions than price, that even were his point true the advantages would be capitalized against the consumer—is rooted in a characteristic fallacy, the assumption that the reproduction-cost method will be applied literally no matter what happens to price. No careful student of commission regulation, aware of the constant necessity, if consumer interest in amount and quality of service (more important than price) are to be served, to protect the credit position of growing utilities, could be guilty of such an error. Reproduction-cost is a "fair weather" method for the regulated companies. They know that during periods of falling prices, their earning power, either through the rate-base or the rate of return, will not be reduced *by regulation* below an amount justified by prudent investment.

Even to list the dubious shibboleths by which the author attempts to build the case for reproduction-cost would require an essay of a length not justified by the importance of the subject. The time has arrived when the subject of utility regulation should be approached with arguments more substantial than empty phrases. Professor Graham's book is too characteristic of the product of the specialist who strays from the field in which his word is authoritative.

MELVIN G. DE CHAZEAU

University of Virginia

Social Pathology in China, by Herbert Day Lamson. Shanghai: The Commercial Press, Ltd. 1934. 607 pp.

The strength of many social movements is centered in a timely book. Even a humble textbook may exert a strong influence on thousands of students and thereby foster a science or develop a profession. This text on the problems of Chinese livelihood, health and family life may stimulate greatly the growth of social statistics, economic surveys, and social service in China. The author has drawn together the rather meager data available on Chinese conditions, using them to adapt the usual American discussion of social problems to the outlook of his students at the University of Shanghai. Although he has been compelled to draw most of his statistics from American sources, he presents a great deal of descriptive material on conditions in China for which no statistics are available. The book is well written and appears to emphasize problems according to their importance in China rather than in America. The author's attitude throughout is remarkably even-tempered and objective. Raw propaganda is excluded yet the book does present an impressive case for social reform and inferentially the great need and opportunity for social and economic research.

The text starts with poverty and pauperism and proceeds to a discussion of standards of living, wages, and income. Here, as elsewhere throughout the book, the author summarizes small studies which have been made in China and presents statistics on similar subjects in the United States. A number of his own

studies are included but in proper proportion and with admirable restraint. Rural and urban problems, housing, illiteracy, and population pressure are also considered.

The section on health begins with a general chapter on sickness, which is followed by chapters on leprosy, tuberculosis, venereal disease, mental deficiency, and mental disease. It closes with a discussion of public health. The third section presents problems of marriage and the family, divorce, desertion, infanticide, child slavery, widowhood, contraception, and education for marriage. The author wisely limits his book to these three sections omitting any detailed treatment of crime, unemployment, recreation, and many other problems. The interconnections between various social, health, and economic conditions are evident throughout the book.

In many instances, quotations are presented uncritically or the author lapses into broad generalizations unsupported by data. In this respect he does not differ from authors of American textbooks. Proverbs are quoted freely and doubtless with good pedagogical results. Excellent bibliographies are presented.

The principal parts of interest to American readers will doubtless be the fragmentary survey data presented and the more distinctly Chinese phases of the problems of extreme poverty, primitive sanitary facilities, and an uneducated population. The problems of family relationships, including those peculiar to the large family and to certain Chinese marriage customs, are interesting additions to the usual American subject matter. One is intrigued by the book to speculate on two questions, "How would a native Chinese sociologist have written it?" and "What future studies of the cost of living, wages, population, housing, public health, and family life will spring from the study of this book?"

FREDERICK F. STEPHAN

Federal Emergency Relief Administration

Compensation in the Professions, by Lester W. Bartlett with the assistance of Mildred B. Neel. New York: Association Press. 1933. xv, 187 pp.

How to determine what are fair and efficient rates of compensation for particular occupations at particular times and places is a troublesome problem of much social importance. It is one with which many philanthropic and other non-profit making organizations are continually harassed. This study, made primarily for the guidance of Y. M. C. A.'s, has attempted to identify the most important principles which should be taken into consideration in determining the salaries of workers of professional grade. A list of sixteen general principles which should influence decisions concerning compensation policies is arrived at, which are of interest and which should be of value for general evaluation of salary practices and policies. For the most part they rest on *a priori* assumptions and cannot be said to be demonstrated by the evidence presented in the study. In general, the evidence offered in support of the argument is illustrative rather than conclusive, and much of the statistical data is definitely faulty.

A primary criticism of the statistics of the study is that data which are at best

very rough approximations are presented without suitable definition or qualification and with no clear explanation of the processes by which they have been derived. As a result they are for most readers quite misleading. Table 10, for example, purports to show the relative difference between the incomes of the average professional family in eighteen American cities for the period 1921 to 1931, inclusive, and in December, 1932. Although no actual data of this sort exist, neither table nor accompanying text explains that these figures are computations of the author, nor is their derivation discussed. References cited at the foot of the table are to the U. S. Bureau of Labor Statistics study of expenditures of families of wage earners and small salary persons in 1918–1919 and to the Bureau's cost of living indexes for individual cities.

Table 3 purports to show comparative data for median and quartile incomes of the members of various professions in the years just prior to the depression. Sources and brief explanation of the method of obtaining these figures are given but the procedure is faulty respecting both the selection and treatment of the data used. Thus, in the case of dentists, data for rural and city dentists have been taken, whereas for teachers the data used are those for cities of over 10,000 population only. The "medians" shown are in many instances the result of averaging medians for separate groups of quite different salary levels, and this is done even where combined distributions could have been obtained. To cite only another instance, Table 5 presents for specified professions median incomes for the first five years of practice compared with median "peak incomes." Inconsistent and in some cases absurd assumptions have been made in selecting data from which these computations are derived, although for some professions, for which the necessary data were available the cited figures are good approximations, for others they are certain to be greatly in error. Such faults tend to discredit the entire publication.

RALPH G. HURLIN

Russell Sage Foundation

Practical Business Statistics, by Frederick E. Croxton and Dudley J. Cowden. New York: Prentice-Hall, Inc. 1934. xiv, 529 pp.

The authors' purpose in presenting this textbook on elementary methods in business statistics, as stated in the preface, is "to present to students who expect to enter business the more elementary statistical procedures that may prove useful to them." These procedures are developed "in connection with applications which are actually being used in business or which might profitably be so used." No pretense to mathematical completeness is made; the emphasis is on application. The reader is referred to standard works on mathematical statistics and least squares for proofs of all but the simpler formulas. The authors hope that the needs of the more elementary courses in business statistics will be fulfilled even though it is impossible to design a text acceptable in every detail to all teachers.

The usual topics—Nature and Classification of Statistical Data; Collection, Tabulation, and Graphic Presentation of Data; Ratios and Percentages; Fre-

quency Distributions; Averages, Dispersion, and Skewness; Unreliability and the Normal Curve; Analysis of Time Series; Construction of Index Numbers; and Correlation—are included in the text. The several chapters are followed by appropriate references, to other textbooks for the most part, and by useful lists of questions. Appendices contain selected lists of readily available sources, a discussion of aids to calculation, and the tables ordinarily needed in elementary statistical work. The discussions dealing with the collection of data, the construction of tables, and unreliability are well rounded out and adequately developed. The chapter on ratios and percentages is excellent and furnishes an appropriate tie-in with the analysis of financial and operating statements. The subject of correlation is the most logically developed of the major topics in the text; the essential principles and relationships between the several measures needed in the description of a correlation are clearly brought out. The chapter on "Types of Correlation" would have been improved by statements regarding the limitations of the several types of correlation presented. The subject of sampling also has been carefully considered throughout the text.

It is to be regretted, however, that the discussions of averages, time series, and index numbers do not show the same excellence of treatment as the topics indicated above. In the treatment of index numbers the subject of weighting is left pretty much in the air by the statement (p. 370) that "it usually makes very little difference which of the various systems of weighting are used." The importance of relating the method of weighting to the purpose for which the index number is to be used has been almost wholly overlooked. In the analysis of time series the principal weakness, in the opinion of the reviewer, lies in the discussion of secular trend. The reader is warned against the dangers of extrapolation, but no recognition is given to the need for considering together the problems of the choice of a type of trend line and the selection of a trend period for a particular set of data ordered in time. The criterion for the choice of a trend line apparently is (p. 338) "as simple a type of curve as can be found which adequately describes the trend." How shall the reader decide when a curve "adequately" describes a trend? The author's treatment of the statistical and economic factors involved in the answer to this question is lacking in clearness and in comprehensiveness. The discussion of averages is the most disappointing of the chapters in the text. The development of principles is subordinated to the elucidation of the practical problems arising in the application of averages in actual situations, particularly time studies. The principles underlying the choice of averages have not been brought out and, although the limitations of particular averages are considered in connection with the specific examples which are presented, the precise significance of averages for all statistical work has not been clearly stated. In one part of the chapter on "Measures of Central Tendency," the reader is led through four pages in the discussion of a method for finding the arithmetic average of a skewed distribution only to find the whole procedure scrapped in the last paragraph in favor of what amounts to the simple average of the actual values of the items in the series.

Although this text follows the lines usually found in texts of this type in the choice of subject matter and topical arrangement, there is a decided departure

from the conventional in the pedagogical approach to the subject. The practical application predominates, and the methods of handling the statistical problems involved are developed around the practical situation. A complete explanation of all the points related to the practical case, whether essential or incidental, results at times, in this text, in the subordination of the method to the illustration. In fact, fundamental principles are, in some instances, either obscured or neglected altogether. While statistical methods should be the tools of the statistician, and not his master, the choice of methods should be based upon definite principles. In this text the organization of this general body of principles and the consideration of the limitations upon statistical methods in the social sciences in general and in business economics in particular are largely left to the instructor. This approximation to the problem method of presenting elementary statistical methods raises the question of the relative value of this method in elementary courses. The reviewer is of the opinion that more satisfactory results can be obtained, particularly in a course in elementary statistical methods, if the development of fundamental principles is based on simple illustrations and is then followed by applications of the principles, by the use of appropriate methods, to practical situations of less or greater degree of complexity. Principles do not change and can be set down in a text without fear of having them become out of date, but in a dynamic economic society applications of principles arise on every hand and can be readily furnished by the instructor; whereas illustrative applications presented in a textbook may easily become obsolete and inapt, thereby decreasing the value of a text from the instructional standpoint. Moreover, the student can approach a text in which the organization of principles is a primary concern with confidence that it will serve as a guide in handling practical problems in whatever form they may arise in particular situations.

IRWIN S. HOFFER

Temple University

British Public Expenditures, 1921–1931, by Joseph Sykes. London: P. S. King and Son, Ltd. 1933. xii, 388 pp.

After a brief introduction, Professor Sykes treats his subject in three parts: (1) a general survey, (2) the economic and social effects, and (3) a general estimate and conclusions regarding desirable reforms. The study is excellent throughout and is a valuable addition to the growing literature which endeavors to show the relationship of specialized aspects of economics to the broader field.

First to catch attention as well as first in its importance is the increase in the total of British public expenditures from £170.4 millions in 1913–14 to an average of £804.8 millions in 1921–1931 and a shift in the relative importance of the various items. The enlarged aggregate amount necessarily means a greater rôle of government in economic affairs and that government financial operations will be of much greater significance to private business.

Also the change in relative amounts is striking. The cost of "Other Services," which includes outlays for general administrative purposes, has grown from

£26.4 millions to £53.8 millions, an increase of only £27.4 millions, while "Unemployment and Economic Development" has grown from £5.7 millions to £47.3 millions; "Social Services" from £33.2 millions to £119.7 millions; "War (Aftermath) Services" from nothing to £92.4 millions; and "National Debt Services" from £24.6 millions to £366.2 millions. "Defence Services," which led as nearly 46 per cent of the total in 1913–1914, increased by only 57 per cent and averaged only a little more than 15 per cent of the total in the period 1921–1931. The greatest increase of all has been in the "National Debt Services," which stood only fourth in importance before the War but are now far in the lead as 45 per cent of the aggregate.

These changes both in size and in distribution have had highly important consequences, and it is these that the author analyzes. While all the items are examined, the most significant, because of the changes in their absolute and relative amounts, are the debt services and the social services. The resulting utilities and disutilities are carefully presented and weighed. The author recognizes that, although taxation is levied as a whole and not for specific categories of expenditure, a mere balancing of taxation as a whole and expenditure as a whole would not be sufficiently enlightening. This compels a combination of the two approaches—the general and the more specific.

The author's conclusions relate to two principal effects. First is the effect on the two broad groups of Richer and Poorer. He finds that certain expenditures, notably those on debt services, accrue to the benefit of the Richer, while others, notably for education, pensions (war and other), housing, and various types of social insurance, are of greater advantage to the Poorer. His general conclusion, after analyzing both taxation and benefits, is that relatively the Poorer are receiving a slightly reduced percentage (from 51 to 48.5) of the benefits but are bearing a considerably reduced percentage of taxation (from 36.8 to 29.6), or "that a net transfer has occurred from Richer to Poorer." Inequality has been definitely modified.

Second are the effects on the community *per se*. Has it gained or lost "as a result of the induced economic reactions"? This is considered under three headings: (1) the volume of national saving; (2) the alteration in demand and supply schedules for goods and services; and (3) the effect on the total of the national income. Professor Sykes concludes on the first point that the volume of foreign investment has declined with certain adverse results, but that this paved the way for an increase in domestic investment. The total real national saving, however, declined. On the second point the author finds that although the changes are less than might have been expected "there has been a substantial increase in the demand for and supply of consumption goods and services with a narrowed gap between total exports and total imports." On the third point he finds that the national income "has been roughly maintainable throughout 1921–31 at virtually as high a real figure as in 1913–1914."

In general, the author concludes that "no dire consequences have ensued for the national economy regarded as a whole"; that "the lessening of social and individual inequality has had profound effects of a highly favorable character"; and that "the massive attack on the problem of poverty has been attended with

distinctly good results and with vital additions to the country's material and non-material welfare."

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Elementary Statistics. An Introduction to the Principles of Scientific Methods, by James G. Smith. New York: Henry Holt and Company. 1934. x, 517 pp.

Professor Smith's *Elementary Statistics* must be viewed as an attempt to bring together within the covers of one text both statistical theory and statistical methods. As the author states there is little that is original except "in matters of arrangement and pedagogical approach," to which should be added the statement that the last part of the book on "The Evolution of Scientific Method" is not usually found in elementary textbooks.

The text is divided into six parts, of varying length: Part I, covering "Quantitative Expression of Facts"; Part II, dealing with "The Study of Static Variability"; Part III, viewing variability from a dynamic point of view; Part IV, dealing with the theories of probability, errors, sampling, and statistical inference as well as statistical logic; Part V, introducing the correlation analysis; and Part VI, devoting attention to "The Evolution of Scientific Method."

In Part I the attention of the reader is directed to the fact that statistics is a study of variations which necessitates the collection of data and their presentation in tables and charts. The student will find almost any other text will give him a better grasp of both the function and the technique of tabulation and charting than the present one. A comparison of Tables 9 and 12 indicates that the author has no standards of presentation of statistical material. The chapter on "Sources of Statistics" is devoted exclusively to a description of those public and private sources which are generally available. The reader, however, will find no critical analysis of them nor are tests suggested by which the user may guide himself through the maze of present day statistical data.

Part II, covering static variability, is concerned with the analysis of frequency distributions. As may be expected, the usual measures of central tendency, dispersion, and skewness are treated. Under the rubric of skewness, however, is included the definition, in mathematical symbols, of the moments about the mean as well as a measure of kurtosis. In a chapter which follows a few rules are given to guide the beginner in setting up frequency distributions, and the discussion plunges into the calculation of the moments about the mean, the Betas, and, for the second time, measures of central tendency, dispersion, and skewness.

Index numbers and the analysis of time series are included under "The Study of Dynamic Variability" in Part III. There is a short history of index numbers and a topic on the "Principle of Sampling Applied to Index Numbers," over half of which is devoted to sampling shells, not prices. Four methods of index number construction are treated. The reviewer cannot agree with the author in weighting price relatives with quantities rather than values. In the analysis of time series the various movements of an hypothetical series are brought to-

gether, which enables the reader to see how each of them enters into the picture. The treatment is admirably worked out, and the student should have no trouble with either method or the statistical logic involved. The last chapter in this part, on "Economic Forecasting," will serve as an introduction to the subject, and the references in the footnotes are sufficient to give the ambitious further light on the subject.

In Part IV the theory of probability is approached from a philosophical rather than mathematical point of view, if one may be permitted to make such a distinction. This is followed by a chapter on "The Theory of Errors and the Theory of Sampling," which follows more or less the usual treatment. The chapters on statistical inference and the logic of statistical method are rather new to elementary texts.

The correlation analysis as applied to two variables is taken up in the fifth part under "The Study of Bivariates." The numerous charts will be helpful to the beginner in grasping not only the method but the theory as well. The chapters are well written and the material easy to follow. There is, however, no treatment of multiple and partial correlation.

Professor Smith's addition of a part (VI) on "The Evolution of Scientific Method" will be pleasing to most teachers and students of statistics. It will be especially valuable to the social scientists. One cannot help being a little disappointed that he did not place more emphasis on the amount of statistical data which has come down to us from the Middle Ages.

It is to be noted that the arrangement of material differs somewhat from that found in most textbooks; for example, it does not include a bibliography at the end of chapters or at the end of the book, although it does include an appendix of tables. Here and there one will find a typographical error, as in the second footnote, page 112, where G. M. = (M x H. ½ M.) is, obviously, written for G. M. = (M x H.M.)^{½}. It is unfortunate that Professor Smith repeats this statement of Tizek, since it is an error. In fairness, it must be stated that he is not the first [1] to follow it. The geometric mean of a series of numbers in geometric progression is the geometric mean of the arithmetic and harmonic means of those numbers. This holds true for this case only and no other.

All in all, Professor Smith has produced a thought-provoking text, which can be read with profit not only by beginners but by those who are professionals. The press-work is good, and the quality of paper is such that eye strain is minimized, which to the statistician is no small point in a book to which he may wish to refer frequently.

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[1] Day, E. E., *Statistical Analysis*, p. 142, footnote 1, where the error was repeated. Mills, F. C., *Statistical Methods*, p. 143, seems to limit it to two numbers. Neither is correct.